



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

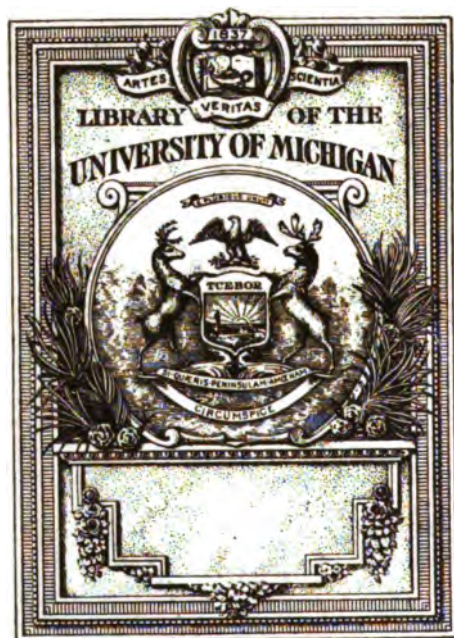
Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

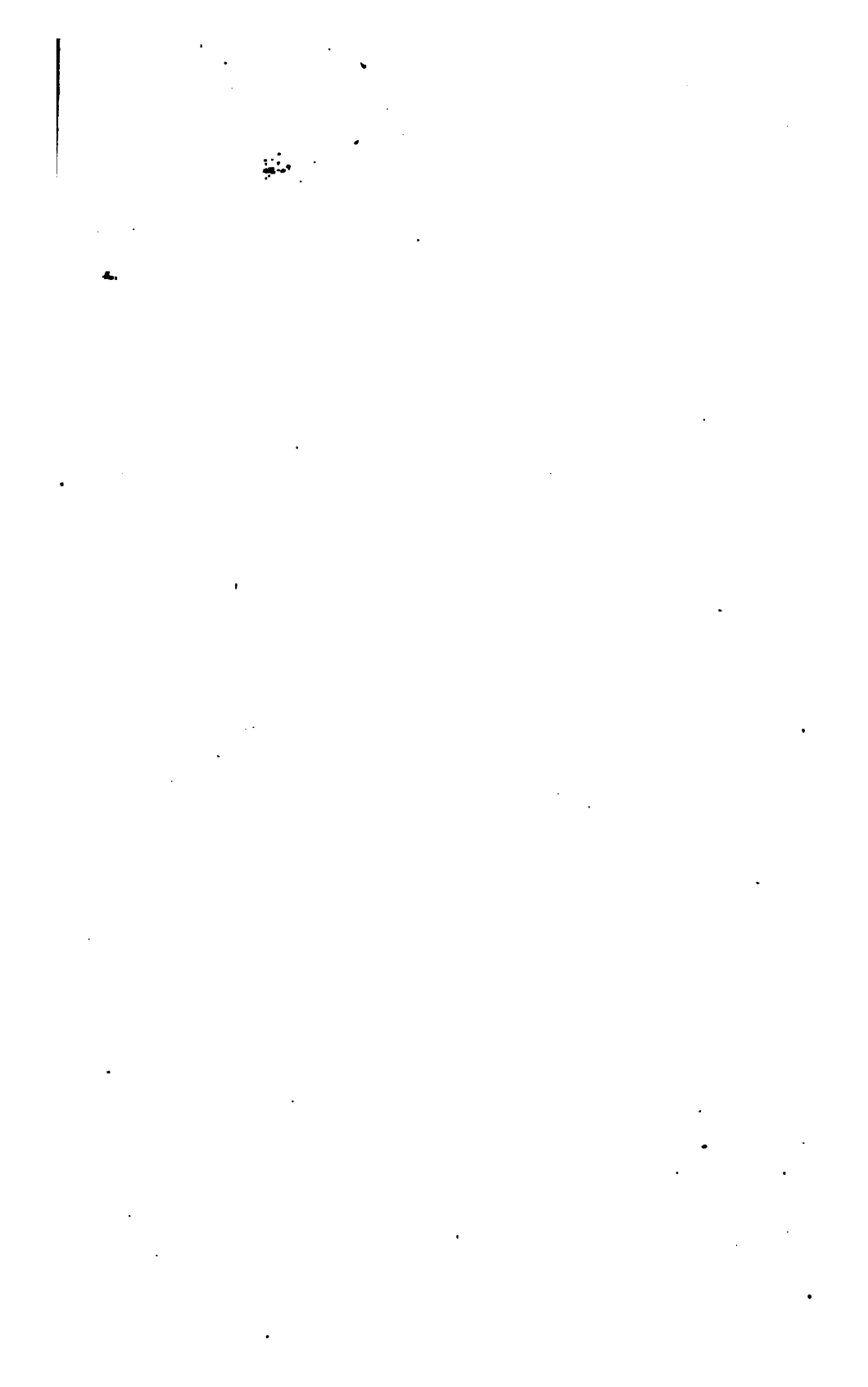
- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>



T
1
N56



THE
LONDON JOURNAL
OF
Arts, Sciences, and Manufactures,
AND
REPERTORY
OF
PATENT INVENTIONS.

CONDUCTED BY
MR. W. NEWTON,
OF THE OFFICE FOR PATENTS, CHANCERY LANE.

(Assisted by several Scientific Gentlemen.)

VOL. XL.
(CONJOINED SERIES.)

LONDON:

PUBLISHED BY W. NEWTON, AT THE OFFICE FOR PATENTS, 66, CHANCERY-LANE, AND MANCHESTER; T. AND W. PIPER, PATERNOSTER ROW; STIMPIN, MARSHALL, AND CO., STATIONERS' COURT; J. MCCOMBE, BUCHANAN ST., GLASGOW; AND GALIGNANI'S LIBRARY, RUE VIVIENNE, PARIS.

1852.

24

R. FOLKARD, PRINTER, DEVONSHIRE STREET,
QUEEN SQUARE.

LIST OF PLATES IN VOL. XL.

[CONJOINED SERIES.]

- I. Willis' Impts. in Organs; and Rose's Impts. in Boilers.
- II. Newton's Machinery for Chipping Stone; Walker's Impts. in Making Tubes; Richardson's Apparatus for Dyeing and Washing; and McDowall's Impts. in Time-keepers.
- III. Morey's Machinery for Dressing Stone; Newton's Impts. in Electric Telegraphs; Crickmer's Impd. Packing; and Fontainemoreau's Impts. in Electric Telegraphs.
- IV. Newton's Impts. in Steam Engines, &c.; Hodges and Brockedon's Surgical Instruments; Wilkins' Impts. in Railway Buffers; and Ermen's Machinery for Finishing Threads.
- V. Howard's Impd. Agricultural Implements; Dickinson and Willan's Impts. in Looms; and Adams' Impts. in Fire-arms.
- VI. Workman's Apparatus for Waterproofing Bricks, &c.; Chance's Impts. in Making Glass; Newton's Portable Bedsteads; Hallen's Impd. Gas Burners; Chatterton's Apparatus for Insulating Telegraphic Wires; and Donaldson's Impts. in Pipes, Drains, Foundations, &c.
- VII. St. John's Impts. in Compasses and Ships' Logs; Newton's Impts. in Ships and Boilers; and Walter's Impd. Knives and Forks.
- VIII. Newton's Machinery for Cutting Files; Barlow's Impts. in Saws; Albright's Apparatus for Preparing Phosphorus; and Mortimer's Impts. in Compasses.

- IX. Diagrams Illustrating the Action of the Forces on the Crank of a Steam Engine, by W. Pole, C. E.
- X. Illingworth's Machinery for Preparing Wool and Hair; Newton's Impts. in Railways; Heindryckx's Impts. in Propelling Vessels; De Bergue's Impts. in Railways; and Brooman's Impts. in Connecting Rails.
- XI. Harrison's Impts. in Weaving and Dressing Yarns; Barlow's Paddle-wheel; Milns and Pickstone's Impts. in Spinning and Weaving Machinery; and Schroder's Evaporating Apparatus.
- XII. Pauwels and Dubochet's Apparatus for Making Coke and Gas.
- XIII. Kossovitch's Impd. Rotatory Engines; Pitcher's Apparatus for Regulating Engines; and Johnson's Annealing Oven.
- XIV. Newton's Machinery for Casting Type; Staite's Impd. Smoking Pipes; Grant's Impts. in Heating; Phillips' Impts. in Smoking Pipes; and Robinson, May, and Doyne's Impts. in Railways.
-

INDEX TO VOL. XL.

[CONJOINED SERIES.]

	Page		Page
Acetic acid, article on the manufacture of	369	Bookbinding, impts. in ornamenting woven fabrics for, Cusson's patent.....	469
Adjudications, Scientific,—		Brewing, articles on.....	29, 114
—, Hancock v. Bunsen	237	Bricks, impd. compounds for making, Parkes' patent.....	436
—, Hartley v. Howland	240	Bricks and tiles, method of waterproofing, Workman's patent.....	194
—, Lister v. Todd	235	Burners, impts. in, Hallen's patent.....	190
—, Mitchell v. Barber....	233	Caps, impts. in, Crook's patent	354
—, Regina v. Steiner ...	71	Carding-engines, impts. in, Illingworth's patent	337
Agricultural implements exhibited in the Great Exhibition:—		—, and in setting the cards of, Newton's patent	341
—Horse-hoes, 41; hand-hoes, 46; manure distributors, 47; reaping and mowing machines, 297; hay-making machines, 471; horse and hand-rakes.....	473	Carriages, impts. in buffers for railway, Wilkins' patent.....	103
Annealing oven, an impd., Johnson's patent	462	Casting type, impts. in, Newton's patent	456
Animal substances, article on preserving.....	200	Celestial Phenomena, 80, 168, 248, 336, 424, 504	
—, impts. in preserving, Borden's patent.....	270	China, impts. in the manufacture of, Hodge's patent	467
—, Fontainemoireau's patent.....	273	Cigar tubes, impts. in, Phillips' patent.....	451
—, Wetterstedt's patent.....	272	Cleansing piece-goods, impts. in, Richardson's patent	13
Bedsteads, impts. in portable, Newton's patent	180	Clocks, impts. in the construction of, M'Dowall's patent....	16
Bitumen, applying to various uses, Dundonald's patent ...	186	Coke, impts. in the production of, Fauwels and Dubochet's patent	425
Bleaching flax and hemp, impts. in, Six's patent.....	178	Coloring properties of madder, impts. in extracting the, Julian's patent	291
— threads, impts. in, Cheotham's patent	184	Compasses, impts. in the mariner's and other, Mortimer's patent.....	289
Boilers, impts. in heating, Grant's patent	465	—, St. John's patent ...	249
—, impts. in preventing and removing incrustation in, Ashworth's patent	112	Copper, impts. in the manufacture of, Parkes' patent.....	284
—, impts. in steam, Newton's patent	276	Cutting files, impd. machinery for, Newton's patent	261
—, Rose's patent.....	25		
Bonnets, impts. in, Crook's patent	354		

	Page		Page
Cutting stone, impd. machinery for, Morey's patent.....	81	changes of the English coast from Beachy Head to Portland, 135;—cast-iron viaduct—construction and duration of railways, 211;—electric telegraphs, 305;—on the use of tubular boilers or flue boilers—on the construction of marine boilers—diaphragm steam generator—drainage of the town of Richmond—swing bridge—lattice-beam viaduct—economy of railways, 388;—railway accidents—	476
—, Newton's patent	19	asbestos gas-stove ...	476
Dials for clocks, barometers, gas-meters, &c., impts. in the manufacture of, Minton and Hoffstaedt's patent	109	—, transactions of the Institution of Mechanical:—	
Disclaimers of parts of inventions and titles to patents, list of	160	Equilibrium canal lift—miners' safety lamp, 141;—	
Diseases, impts. in curing certain, Fontainemoreau's patent	273	improved boiler for marine engines—brake for railway carriages—continuous expansion steam-engine, 396;—	
Distilling, articles on 29,	114	supplementary paper on the continuous-expansion steam-engine	480
Doors, impts. in, Lillie's patent	450	Engines, the action of the forces on the crank of steam.....	292
Drains, impts. in the construction of, Dundonald's patent	186	—, impd. apparatus for regulating motive power, Pitcher's patent	445
Dressing stone, impd. machinery for, Morey's patent.....	81	—, impts. in rotatory steam, Kossovitch's patent.....	441
—, Newton's patent	19	—, impts. in steam and other, Newton's patent	95
—, yarns, impts. in machinery for, Harrison's patent...	347	Exhibition, descriptions of the agricultural implements in the Great	41, 297, 470
Dyeing piece-goods, impts. in, Richardson's patent.....	13	Fabric, an impd. manufacture of feather, Booth's patent ...	111
—, threads, impts. in, Cheetham's patent	184	Fabrics, impts. in preserving sail-cloth and other, Wetterstedt's patent	272
Earthenware and porcelain, impts. in the manufacture of, Hodge's patent.....	467	Fibrous substances, impts. in machinery for preparing, Feather and Driver's patent	466
—, manufacturing dials for clocks, barometers, &c., of, Minton and Hoffstaedt's patent	109	Files, impd. machinery for cutting, Newton's patent....	261
Electric telegraphs, impts. in, Fontainemoreau's patent.....	104	Finishing yarns or threads, impts. in, Ermen's patent ...	92
—, Newton's patent.....	86	Fire-arms, impts. in rifles and other, Adams' patent	172
—, impts. in insulating the wires of, Chatterton's patent	195	Furnaces, impts. in, Parkes' patent.....	436
—, Dundonald's patent	186	Gaiters, impd. method of fastening down, Hyam's patent	18
Electrical condition, in its relation to heat, meteorology, epidemic diseases, ventilation, &c.....	383	Gas, impts. in manufacturing and regulating the circulation of, Pauwels and Dubochet's patent.....	425
Enamelling wrought-iron tubes, impts. in, Kenrick's patent...	283		
Engineers, article on the dispute between the employers and the operative.....	127		
—, transactions of the Institution of Civil:—Rotating chambered-breech fire-arms—railway works, 50;—local changes of the English coast from the Thames to Beachy Head—general meeting—President's address—local			

	Page		Page
Gas burners, impts. in, Hal- len's patent	190	Paddle-wheels, impts. in, Bar- low's patent	366
Glass, impts. in ornamenting, Ritchie's patent	367	Paints, compositions to be used as, Newton's patent	191
—, impts. in the manufac- ture of, Chance's patent	182	Paper, impts. in preparing to prevent transfers of writing or printing therefrom, Glynn and Appel's patent	197
—, Hodge's patent	467	Papier-maché, impts. in manu- facturing, Bielefeld's patent ..	21
Gold, impts. in refining, New- ton's patent	433	Patent law reform	49, 134
Governors of steam-engines, impts. in, Newton's patent ..	95	Patents, lists of new, granted in England, 75, 163, 243, 380, 420, 499	
Gutta-percha, impts. in the preparation of, Moulton's pa- tent	363	— in Ireland, 74, 161, 241, 417, 496	
—, Newton's patent ..	9	— in Scotland, 74, 162, 242, 329, 418, 497	
Hair, impd. machinery for pre- paring, Illingworth's patent ..	337		
Harrows, impts. in, Howard's patent	169		
Hata, impts. in, Crook's pa- tent	354		
Heating boilers, impd. mode of, Grant's patent	465		
Horse-shoes, impts. in, Lillie's patent	450		
India-rubber, impts. in the pre- paration of, Moulton's patent ..	363		
—, Newton's patent ..	9		
Iron, impts. in annealing ar- ticles of, Johnson's patent ..	462		
—, impts. in the manufacture of, Hazlehurst's patent	282		
Kamptulicon, impts. in pre- paring, Bunn's patent	365		
Knives and forks, impts. in, Walker's patent	260		
Lead, impts. in separating sil- ver from, Parkes' patents ..	436, 439		
Madder, impts. in extracting the coloring properties of, Julian's patent	291		
Malt, an account of the manu- facture of	29		
Metals from copper, manufac- turing metallic alloys and separating other, Parkes' pa- tent	284		
Milking cows, apparatus for, Hodges and Brockedon's pa- tent	106		
Organs, impts. in the construc- tion of, Willis' patent	1		
Ornamenting glass, impts. in, Ritchie's patent	367		
— woven fabrics for bookbinding, impts. in, Cus- son's patent	469		
Packing stuffing-boxes and pis- tons, impts. in, Crickmer's patent	04		
		PATENTS, REPORTS OF RECENT.	
		Adams, R., for impts. in fire- arms	172
		Albright, A., for impts. in the manufacture of phosphorus ..	278
		Appel, R., and Glynn, H., for preparing paper to prevent the transfer of printed im- pressions contained thereon ..	197
		Ashworth, J., for impts. in pre- venting incrustation in steam- boilers	112
		Barlow, C., for impts. in saws ..	274
		—, for impts. in paddle- wheels	366
		Bielefeld, C. F., for impts. in manufacturing sheets of pa- pier-maché	21
		Birkett, W., for a method of obtaining soap from wash- waters	118
		Booth, J. P., for an impd. ma- nufacture of fabric	111
		Borden, G., for impts. in pre- serving animal and vegetable substances	270
		Brockedon, W., and Hodges, R. E., for impts. in surgical instruments	106
		Brooman, R. A., for impts. in railways	358
		Bunn, L. St. L., for impts. in the manufacture of kamptu- licon	365
		Chance, J. T., for impts. in the manufacture of glass	182
		Chatterton, J., for impts. in in- sulating electro-telegraphic wires	195

	Page		Page
Cheetham, J., for impts. in the manufacture of threads or yarns	184	Hodges, R. E., and Brockedon, W., for impts. in surgical instruments	106
Crickmer, R. J., and F. W., for impts. in packing stuffing-boxes and pistons	94	Hoffstaedt, A. J., and Minton, H., for impts. in manufacturing faces or dials for clocks, barometers, &c.	109
Crook, J. R., for impts. in hats, caps, and bonnets	354	Howard, J., for impts. in ploughs and other agricultural implements	169
Cussons, T., for impts. in ornamenting fabrics for bookbinding	469	Hyam, B., for a method of fastening down trousers, &c. ...	18
De Bergue, C., for impts. in railways	360	Illingworth, D., for impd. machinery for preparing wool and hair	337
Dickinson, W., and Willan, R., for impts. in looms	176	Jackson, W., for impts. in the manufacture of soap	287
Doyno, W. T., Robinson, J., and May, C., for impts. in railways	449	Johnson, R., for impts. in annealing articles of iron, &c. .	462
Driver, J., and Feather, J., for impts. in screw-gill machinery	466	Julian, D., for impts. in extracting the coloring properties of madder	291
Dubochet, V., and Pauwels, A., for impts. in the production of coke and gas	425	Kenrick, T., for impts. in enamelling and glazing wrought-iron tubes	283
Dundonald, Earl of, for impts. in constructing sewers, water-ways, reservoirs, &c. ...	186	Kossowitch, G., for impts. in rotatory steam-engines	441
D'Urole, F. C. V. L. L., for a mode of increasing the produce of autumn wheat	199	Lillie, Sir J. S., for impts. in forming roads, floors, doors, &c.	450
Ermen, G., for impts. in finishing yarns or threads	92	Masson, E., for impts. in preserving vegetable substances	267
Feather, J., and Driver, J., for impts. in screw-gill machinery	466	May, C., Doyno, W. T., and Robinson, J., for impts. in railways	449
Fontaine moreau, P. A. le Comte de, for impts. in electric telegraphs	104	Mc Dowall, C., for impts. in the construction of time-keepers ..	16
_____, for impts. in preserving animal substances	273	Milns, J. C., and Pickstone, S., for impd. machinery for spinning and weaving	343
Glynn, H., and Appel, R., for preparing paper to prevent the transfer of printed impressions contained thereon .	197	Minton, H., and Hoffstaedt, A. J., for impts. in manufacturing faces or dials for clocks, barometers, &c.	109
Grant, J., for impts. in heating and regulating temperature .	465	Morey, C., for impd. machinery for dressing, cutting, and shaping stone	81
Hallen, H., for impts. in gas-burners	190	Mortimer, J., for impts. in compasses	289
Harrison, J., for impts. in looms and machinery for sizing yarns	347	Moulton, S., for impts. in preparing gutta-percha & caoutchouc	363
Hazlehurst, I., for impts. in the manufacture of iron	282	Newton, A. V., for impts. in treating caoutchouc and gutta-percha	9
Heindryckx, F., for impts. in propelling vessels.....	359	_____, for impd. machinery for cutting and dressing stone	19
Hodge, W., for impts. in the manufacture of glass, china, earthenware, and artificial stone	467	_____, for impts. in electric telegraphs	86

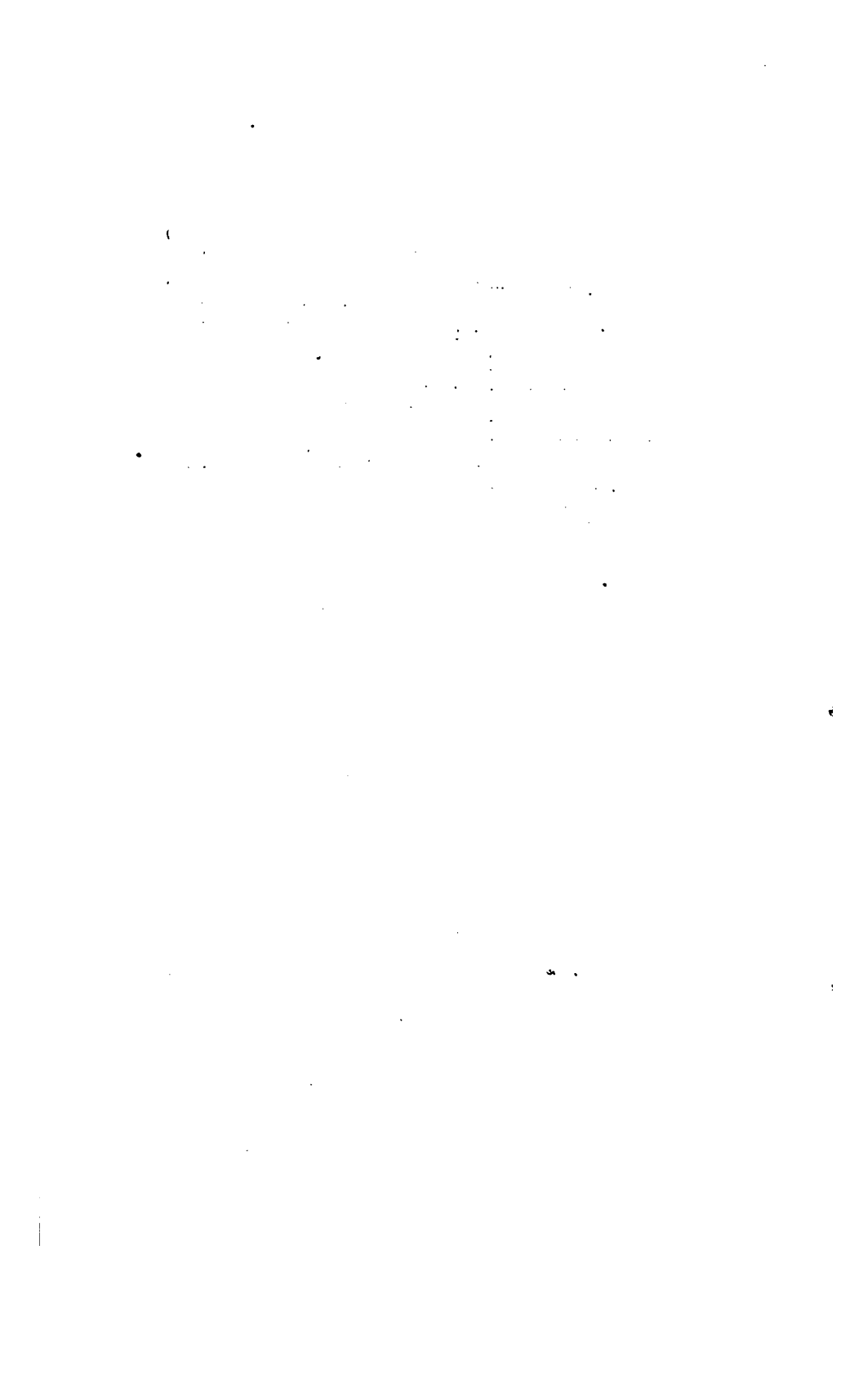
	Page		Page
Newton, A. V., for impd. compositions for preserving wood, metals, &c.	191	Staite, W. E., for impts. in smoking pipes, and apparatus connected therewith	455
—, W. E., for impts. in steam and other engines.....	95	Walker, S., for impts. in the manufacture of metallic tubes	24
—, for impts. in portable bedsteads	180	Walters, J., for impts. in knives and forks	260
—, for impd. machinery for cutting files	261	Wetterstedt, Baron C., for impts. in preserving animal and vegetable substances	272
—, for impts. in constructing ships, and in steam-boilers	276	Wilkins, W. C., for impts. in railway-buffers.....	103
—, for impts. in carding-engines, and in preparing the cards thereof.....	341	Willan, R., and Dickinson, W., for impts. in looms	176
—, for impts. in railways	356	Willis, H., for impts. in the construction of organs	1
—, for impts. in refining gold.....	433	Workman, J., for a method of waterproofing bricks, tiles, &c.....	194
—, for impts. in casting type	458		
Oxland, R. and J., for impts. in manufacturing and refining sugar	27	Paving, impts. in, Lillie's patent	450
Parke, A., for impts. in manufacturing copper and producing alloys	284	Phosphorus, impts. in the manufacture of, Albright's patent	278
—, for impts. in smelting and treating metals, &c.	436	Pistons, impts. in packing, Crickmer's patent	94
—, for impts. in separating silver from other metals	489	Plaster, compositions for preserving, Newton's patent ...	191
Pauwels, A., and Dubochet, V., for impts. in the production of coke and gas	425	Ploughs, impts. in, Howard's patent	169
Phillips, G., for impts. in smoking pipes and cigar tubes ...	451	Preserved meats for the naval service, article on	200
Pickstone, S., and Milns, J. C., for impd. machinery for spinning and weaving	343	Preserving animal and vegetable substances, impts. in, Borden's patent	270
Pitcher, L. B., for impd. regulator, for motive-power engines	445	—, Wetterstedt's patent	272
Richardson, J., for impts. in dyeing and cleansing piece-goods	13	— corpses and anatomical parts, impts. in, Fontainemoreau's patent	273
Ritchie, W. H., for impts. in ornamenting glass	367	— vegetable substances, impts. in, Masson's patent	267
Robinson, J., May, C., and Doyme, W. T., for impts. in railways	449	— wood, metals, plaster, &c., compositions for, Newton's patent	191
Rose, E., for impts. in steam-boilers	25	Printing types, impts. in casting, Newton's patent	458
Schroder, H., for impts. in manufacturing and refining sugar	355	Prints, preventing the transfer of, Glynn and Appel's patent	197
Six, H., and A., for impts. in bleaching flax and hemp ...	178	Propelling vessels, impts. in, Heindryckx's patent	359
St. John, J. R., for impts. in compasses and ships' logs ...	249	Railway buffers, impts. in, Wilkins' patent	103
		Railways, impts. in, Brooman's patent	358

	Page		Page
Railways, impts. in, De Bergue's patent	360	in metal, wood, &c., 311; philosophical instruments and processes, 317;—civil engineering and machinery generally, 323;—arts and manufactures of India, 403;—naval architecture and lifeboats, 410;—agricultural progress and implements, 486;—production of the flax plant, and the preparation of its fibre for manufacture	492
—, Lillie's patent...	450	Sowing wheat, impd. method of, D'Urcle's patent	199
—, Newton's patent	356	Spinning machinery, impts. in, Milns and Pickstone's patent	343
—, Robinson, May, and Doyne's patent	449	Spirit from water that has been used in treating madder, obtaining, Julian's patent	291
Refining gold, impts. in, Newton's patent	433	Stone, impd. machinery for cutting and dressing, Morey's patent	81
Sail-cloth, impts. in preserving, Wetterstedt's patent	272	—, Newton's patent	19
Saws, impts. in, Barlow's patent	274	—, impts. in the manufacture of artificial, Hodge's patent	467
Screw gill machinery, impts. in, Feather and Driver's patent	466	Stuffing-boxes, impts. in packing, Crickmer's patent	94
Ships, impd. apparatus for ascertaining the velocity of, St. John's patent	249	Sugar, impts. in manufacturing and refining, Oxland's patent	27
—, impts. in propelling, Barlow's patent	366	—, Schroder's patent	355
—, Heindryckx's patent	359	Surgical instruments, impts. in, Hodges and Brockedon's patent	106
—, impts. in protecting the bottoms of, Dundonald's patent	186	Threads, impts. in finishing, Ermen's patent	92
—, impts. in the construction of, Newton's patent	276	—, impts. in manufacturing bleached colored or party-colored, Cheetham's patent	184
Signals, impts. in communicating by electricity, Fontaine-moreau's patent	104	Timekeepers, impts. in the construction of, McDowall's patent	16
—, Newton's patent	86	Tobacco-pipes, impts. in, Phillips' patent	451
Silver, impts. in separating from copper, Parkes' patent	284	—, Staite's patent	455
—, impts. in separating from lead, Parkes' patents ...	436, 439	Trousers, impts. in fastening down, Hyam's patent	18
Sizing yarns, impts. in machinery for, Harrison's patent ..	847	Tubes, impts. in enamelling and glazing wrought-iron, Kenrick's patent	283
Smelting copper, impts. in, Parkes' patent	284	—, impts. in manufacturing, Dundonald's patent ...	186
Soap, impts. in the manufacture of, Jackson's patent	287	—, Walker's patent	24
—, from wash-waters, impts. in obtaining, Birkett's patent ..	113	Types, impts. in casting printing, Newton's patent	458
Society of Arts:—Lectures on the Great Exhibition,—inaugural lecture, 56;—mining, quarrying, and metallurgical processes and products, 63;—raw materials from the animal kingdom, 146;—chemical and pharmaceutical processes and products, 156;—chemical principles involved in the manufactures of the Exhibition, 217;—substances used as food, 222;—vegetable substances used in the arts and manufactures, 227;—machines and tools for working		Valves for steam-engines, impts. in, Newton's patent	95
		—, Pitcher's patent	445

INDEX.

xi

	Page		Page
Vegetable substances, impts. in preserving, Borden's patent .	270	Wheels for carriages, impts. in, Lillie's patent	450
———, Masson's patent 267		——— for ploughs and other agricultural implements,— impts. in, Howard's patent...	169
———, Wetterstedt's patent	272	White-lead, article on the manufacture of	377
Walls, impts. in, Lillie's patent	450	Wire, an impd. oven for annealing iron, Johnson's patent	462
Waterproofing bricks, tiles, &c., method of, Workman's patent	194	Wires of electric telegraphs, impts. in insulating the, Chat-terton's patent	195
Water-ways and reservoirs, impts. in constructing, Dun-donald's patent.....	186	———, Dundonald's patent	186
Weaving, impts. in looms for, Dickinson and Willan's pa-tent	176	Wool, impd. machinery for pre-paring, Illingworth's patent	337
———, Harrison's pa-tent	347	Yarns, impd. machinery for dressing or sizing, Harrison's patent	347
———, Milns and Pick-stone's patent	343		
Wheat, method of increasing the produce of, D'Urcle's pa-tent	199		



THE
LONDON JOURNAL,
AND
REPERTORY
OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXLI.

RECENT PATENTS.

To HENRY WILLIS, of Manchester-street, in the county of Middlesex, organ builder, for improvements in the construction of organs.—[Sealed 28th February, 1851.]

THE objects sought to be attained by the present invention are, first, to give a rapid utterance to organ pipes of large dimensions, and that with a decreased expenditure of muscular power on the part of the organist; second, to improve the effect of the swell-organ, and bring the tone of the pipes in the swell-box under more perfect command than heretofore; third, to steady the action of the bellows-levers, draw-stops, swell-shutters, composition-pedals, and like moving parts, and prevent all unnecessary friction between vibrating arms and levers, and their bearings or chases; fourth, to bring the stops more thoroughly under the command of the performer, so that he can effect a variety of changes, by putting in or drawing out such stops as may be required, without the use of pedals, as heretofore, and without removing his hand from the key-board; and, fifth, to effect a saving of space by improving the arrangement of some of the internal parts of the organ.*

The first head of the invention includes three improvements in the construction of valves. In Plate I., fig. 1, is a side, and fig. 2, a plan view of a new construction of valve, intended principally to be applied to the pedal organ. This valve is provided with two rectangular openings for the passage of the wind; and they are each supplied with a grating

* The improvements embraced by this patent obtained for the inventor the Council Medal of the Great Exhibition.

to support the valve covers, which are composed of flexible leather *a*, or of vulcanized sheet rubber, covered with a woven fabric on one side only, to prevent its stretching. The peculiarity of this valve is, that it opens by the rolling up of the valve cover: by which means the great resistance offered by the pressure of the wind in the air chamber to the opening of large valves—hitherto so detrimental to developing the capabilities both of the organ builder and performer—is counteracted; and thus the builder is enabled to increase the capacity of the instrument, without the fear of its being beyond the muscular power of the player to bring the various stops into use, as they may be required, for the efficient performance of any given piece of music. The pieces of flexible material *a*, forming the valve covers, are affixed, at one edge, to the valve seat, by means of a cross bar *b*, bolted thereto, and, at their other edge, to a roller *c*. The diameter of this roller is enlarged at the part *c**; and to this enlarged part is attached a band or tape *d*, which is connected, by a wire, at *e*, to the tracker or connecting rod from the pedal or the key, in the usual way of connecting valves with such parts of the organ. By the depression of the key or the pedal, the tape *d*, is drawn in the direction of the arrow 1, and the roller is caused to move in the direction of the arrow 2, and thus uncover the valve-opening. In order to bring back the roller and cover the valve immediately the pressure of the key or pedal is removed, the extremities of the roller are made of a less diameter than the part on which the valve cover is wound; and to these parts, tapes *f*, *f*, are attached, which are connected, at their opposite ends, to coiled springs, secured by pins to a stationary bar. The action of this elastic attachment is, that it will yield to the pull of the tape *d*; and as soon as the pressure of the key or pedal ceases, it will cause the roller to return and cover the opening in the valve. In order to understand this action, it should be remembered that the effect of giving the roller three different diameters, and attaching it as shewn, is to make it a rolling lever, having its fulcrum in the line of the valve cover; the drag therefore upon it by the tapes *d*, and *f*, although they are both in the same direction, will, from the fact of being on opposite sides of the fulcrum, cause the roller to move in opposite directions. In order that this valve may answer readily to the touch of the performer, its roller is made of hollow light wood, or of paper.

Instead of attaching the valve cover to a roller, as above described, the patentee sometimes adopts the following modification, which admits of a very efficacious, secure, and

noiseless valve being constructed:—In place of using the roller, the valve cover is attached to a piece of wood, or other light substance, which is a segment of a much larger cylinder than the roller; and applied to the middle thereof is a still larger segment, to which the central tape is secured, as in the former case. When, therefore, a drag is put on this tape to open the valve, the segment will rock and lift up the cover in like manner to the roller. A similar means to that above mentioned is also employed for returning the cover to the valve-seat. In both these instances, the soundness of the valve is insured by the pressure of the wind upon the valve cover.

Another improved construction of valve is shewn in section at fig. 3. Instead of using a hinged flap of wood, coated with leather, for closing the valve-opening, a piece of elastic sheet-brass *a*, somewhat longer than an ordinary wooden valve, is employed; and it is fixed in its proper position by a screw—a pin being set behind it, to keep the valve in its place. The brass is curved and bedded exactly as a trumpet-tongue fits its reed. *b*, is the spring for assisting in keeping the valve close up to its seat; and *c*, is a wire, connected to the extremity of the valve, for the purpose of pulling it open. It will be understood that the action of this valve is somewhat like that before described, inasmuch as it is not required to overcome the first resistance of the wind in the same manner as the rigid valves heretofore used; but, by reason of the elasticity of the brass, it is enabled to uncover the opening gradually, instead of by a sudden effort.

The second head of the invention, which refers, as before stated, to the swell-organ, consists in placing the bellows, which supply that organ with wind, in the swell-box itself; so that the air, as it is expelled from the pipes, is drawn into the bellows, and used again. The effect of this novel application of the bellows is, that the compression of air in the swell-box, when the front is closed, and the pipes of the swell-organ are sounding (and consequently emitting wind from the external bellows), is entirely prevented; and thus the liability of the pipes to speak out of tune, by reason of the vibration being checked, is avoided, and a more subdued tone is obtainable than by the plan ordinarily in use—there being no tendency for the air to force a passage through the crevices of the swell-box.

The improvements forming the third head of the invention are as follows:—Instead of having a cylindrical fulcrum-pin for the bellows-levers, and affixing the same in the levers by

means of collars, that bind against the sides of the levers, the fulcrum-pin is tapped with a coarse thread, and screwed into the lever: whereby all tendency for the lever to get loose upon its pin is removed, and the steady and comparatively noiseless working of the bellows is also ensured. When attaching a trace to its lever with the threaded centre-pin, a square thread is preferred to be used. The threaded centre-pin is passed through the forked end of the trace and through the lever,—the lever being set in such a position that it will be clear of the sides of the trace; and, as no tendency can exist to alter the relative position of the parts, all friction between the trace and the lever will be avoided so long as the joint remains sound. Threaded centre-pins are also intended to be employed in connecting together the parts which communicate the action of the draw-stop rod to the slide. The draw-stop rod is connected to the "square" or bell-crank-lever, the fulcrum of which consists of a threaded pin; and the connection of the square with the trace leading to the slide is effected by a similar pin. From these examples, it will be evident that the threaded pin is applicable in all cases throughout the organ where steady bearing-pins or firm hinge connections are required for vibrating levers or moveable arms.

The fourth head of the invention refers, as before stated, to a means of drawing and shutting off the stops; and, in order to assist the performance of this operation, the patentee avails himself of what is now generally known in the trade as the pneumatic lever: whereby the air compressed by the bellows is made the motive power for working the stop-rods and the machinery in connection therewith.

The patentee first gives the following description of the action of the pneumatic lever, as applied to the clavier, in order that an important improvement, which he has effected in its construction, may be clearly understood; and then he shews the connection of the lever, or rather of a series of these levers, with the stop-rods and slides. Fig. 4, represents, in longitudinal elevation (partly in section), a pneumatic lever and its appendages, with the improvement applied thereto; and fig. 5, is a view of one end of the same. *a*, is a chamber, supplied with compressed air from the organ bellows; and, in this chamber, a series of holes are cut, for the purpose of forming a communication between the chamber and a series of small bellows *b, b*, placed above it—one over each opening. On the other side of the openings, within the air-chamber, valves or pallets *c*, are fitted, for the purpose of

closing the same and cutting off the passage of air to the bellows, or, as they are termed, the pneumatic levers. Each valve is kept up to its seat by the pressure of the air in the chamber *a*, assisted by the pressure of a spring *d*. To the extremity of each valve *c*, a rod *e*, is attached, which forms a connection between the valve and the long arm of a rocking-lever *f*. This lever is acted upon by the depression of one of the keys by the performer,—such movement being communicated, through the rod *g*, to that lever, whereby it is drawn into the position shewn at fig. 4, when the pneumatic lever is required to act. The effect of this is to pull open the valve *c*, and admit air into the bellows *b*, which, having connection through the rod *h*, with the valves of the organ, will cause it to open the same and allow the pipes to speak. This action will be instantaneous; and, immediately the performer withdraws his finger from the key, the valve *c*, will be closed by the spring *d*, and draw up the long arm of the lever *f*; while, at the same time, it depresses the shorter arm of the lever, which is connected by a rod *i*, to a valve (termed by the patentee his improved compensating escape-valve), and, by raising it, opens a vent. This valve is intended to rise and allow the air to escape after the pneumatic lever has effected the opening of the valves before mentioned; and, in order that it may act without any great power being required in the spring *d*, it is constructed in the following manner:—*k*, is a lever, having its fulcrum at *l*; and, to the opposite ends of the lever, the valve-covers *m*, *m**, for closing the air-vents *n*, *n*, are attached,—the one for acting against the outside and the other against the inside of the stationary part of the pneumatic lever. The face of the inner cover *m**, is somewhat larger than that of the outer cover *m*,—whereby the pressure of the wind is made to assist in closing the valve; and a slight spring *o*, attached to the cover *m*, may be also employed for a like purpose.

The improved mechanism, whereby the performer is enabled to throw any combination of stops into or out of use, through the agency of the pneumatic lever, is as follows:—Fig. 6, is a plan view of two claviers; say, for the great and the choir organ,—some of the keys of the great organ being removed, to shew the construction of the parts beneath; and fig. 7, is a sectional elevation of the same. *a*, *a*, *a*, are the key slips; and *b*, *b*, *b*, are studs, or buttons, attached to horizontal rods or wires, *c*, which pass through holes in the key-slips, and are capable of moving freely therein. It is by the driving in of these buttons, which can be effected by the

thumb of the performer while in the act of playing (as shewn in the enlarged view, fig. 8), that the pneumatic levers are started into action, and made to draw or shut off the stops, or any combination of stops, that may be required to be suddenly thrown out of or brought into use for the efficient rendering of particular effects in musical compositions. In order to render this part of the invention perfectly clear, the patentee has traced out a single stop-movement, and likewise a movement for actuating a "composition," or an arbitrary combination of stops. First, with regard to the single stop-movement:—the stud b^1 , in the key-slip of the great organ, is connected by the wire c^1 , to the arm d^1 , of a horizontal roller e^1 , which extends from one end to the other of the key-board, and is capable of rocking in the bearings that support it. One extremity of this roller e^1 , is bent, so as to form a second arm, at right angles to d^1 , and to it a vertical rod f^1 , is attached: when, therefore, the stud b^1 , is driven in, the roller e^1 , will be rocked in its bearings, and depress the rod f^1 . The upper end of this rod f^1 , is connected to the valve-lever of a pneumatic apparatus, similar to that described with reference to fig. 4. This connection is shewn at fig. 9, which represents, in front view, several pneumatic levers, arranged somewhat after the manner in which they might be packed in the organ. Fig. 10, also shews this attachment—the pneumatic levers being, in this instance, in longitudinal section. It will be unnecessary here to repeat how the pneumatic lever is thrown into action by the pulling down of the rod f^1 ; but it will be at once understood that wind being admitted into the bellows g^1 , it is caused to expand instantly. On the top of the bellows rests a vertical rod h^1 , which is connected to a bell-crank lever, or "square," similar to that shewn at i , fig. 10; and this, again, is attached to a "tracker" or rod k , which is connected to an arm of a roller l . A similar tracker, from another arm on this roller, connects it with a square valve-lever m , which actuates the valves of a second pneumatic lever, acting under a pressure of air like the former. By the T-square lever being driven into the position shewn in the drawing, air will be let into the bellows n , in connection with the trace o , which commands the slides p, p ; and thus (by the expansion of the bellows) the trace o , will be driven in the direction of the arrow, and cause the holes in the slides to come into coincidence with the holes in the sound-board. Each trace is capable of being acted upon by two bellows, for the purpose of being driven either to the right or left, as required, and thereby moving the slides, so as to open or

shut off the stops to which they respectively belong. The manner in which the bellows are arranged for this purpose is shewn in plan view at fig. 11; but other arrangements may be adopted, as may be thought most convenient. It will be understood, that for each bellows there is a distinct valvular apparatus; and the bellows being arranged in pairs, to work the slides in opposite directions, the action of the parts is so arranged that only one bellows of each trace can be inflated at the same time. Thus, supposing the bellows *a*, fig. 11, to have been just inflated, and caused to act upon the slides, the bellows *a**, which acts on the same tracker, will be collapsed as shewn. The object of employing a second set of pneumatic levers, is to afford increased facilities for drawing or cutting off a great number of stops simultaneously. Thus, supposing there to be twelve trackers, connecting the roller *l*, with twelve pneumatic levers, it is obvious that on the performer driving in the stud *b*¹, fig. 6, and, through its connections, causing the roller *l*, to rock, the twelve pneumatic levers will be caused to act simultaneously each upon its respective stop; but these will all belong to one and the same organ.

It now remains to explain how the pushing in of one of the studs in the key-slip of, say, the great organ, can be made to act upon the stops of the swell and choir organ. One movement for effecting this change of stops is indicated in the drawing by reference letters. The number of stops thus combined is arbitrary, and the whole is termed a "composition" or combination; and, according to the compass of the organ, will the number of compositions be determined. If now the stud *b*², be pressed in, it will, through the wire *c*², and arm *d*², cause the roller *e*², to rock,—the bent end of which is connected by a vertical wire 1, with an arm of a roller 2. This roller forms the medium of connection between the three organs, and is provided with four projecting arms. One of these receives, through the wire 1, the impulse given to the stud *b*², and communicates it to the roller. Another arm transfers this motion through the wire 3, to the roller *e*³, and thence through the wire *f*², to the first set of pneumatic levers, and so to the great organ stops, in the manner already described. The third acts upon the wire 4, which rocks the roller *e*, of the swell organ, and thereby communicates, through its wire *f*, the necessary motion for drawing the stops of the swell organ. The fourth arm acts upon a wire 5, which causes a roller *e*, of the choir organ to rock, and thereby communicate through a tracker, similar to that marked *g*, the motion for drawing the stops of the choir organ.

It will be unnecessary to follow these movements further, because each organ is similarly provided with pneumatic levers; and the action of those for the great organ having been explained, the organ builder will readily trace the movement in the other cases. By continuing the movement to the pedal organ, a similar effect may be produced upon the stops of that organ. Throughout the foregoing explanation of the improved arrangement for drawing and shutting off the stops, the effect is described as being produced by acting on the studs of the great organ; but it is obvious that, whatever clavier the performer may be using, analogous facilities will be within his reach, through the arrangements of studs on each key-slip.

The last head of the invention refers to the packing of the pneumatic levers in the organ, so as to avoid the useless multiplication of air-chambers, for supplying the bellows with air, and thereby saving, at once, considerable space in the organ, and effecting an economy in the manufacture. This improvement is shewn at figs. 4, and 5, and consists simply in arranging the bellows in two tiers, and carrying up an air-passage to the second tier between any two adjoining bellows on the lower line.

The patentee claims, as his improvements in the construction of organs, First,—the constructions of valves above described; by which he is enabled to overcome the resistance of the air gradually, instead of by a sudden impulse, which is the action of ordinary valves. Secondly,—supplying the bellows of the swell organ exclusively with air drawn from the swell-box, for the purpose above set forth. Thirdly,—the employment of threaded centerings for the purposes above mentioned, or any analogous use in organs. Fourthly,—bringing the stop-movements within reach of the performer's hands; so that, by the use of manual power, he may, without removing his hands from the key-board, be enabled to draw or shut off any composition of stops, as may be required; and, further, the application to pneumatic levers of the improved escape-valve,—whereby the reiterating power of the pneumatic lever is greatly increased, and the touch of the organ is improved. And, lastly,—the mode of arranging the pneumatic levers, as above described.—[*Inrolled August, 1851.*]

To ALFRED VINCENT NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in the preparation of materials for the production of a composition or compositions applicable to the manufacture of buttons, knife and razor handles, inkstands, door knobs, and other articles where hardness, strength, and durability are required,—being a communication.—[Sealed 4th March, 1851.]

THIS invention relates to the preparation and treatment of caoutchouc and gutta-percha, either alone or in combination, for the purpose of producing a new manufacture or composition, applicable to various uses where hardness, strength, and durability are required. The composition designed to be produced will possess some of the characteristics of horn, ivory, and jet, and may, according to the color imparted to it, be employed in place thereof; or it may be used as a substitute for costly woods, and be applied to furniture in the form of veneer.*

In treating caoutchouc for this purpose, it is combined with sulphur,—the best proportion being about equal parts, by weight, of each ingredient. By combining sulphur, in this proportion, with the caoutchouc, and subjecting the compound to the curing operation (hereafter to be described), a hard substance will be produced; but a still better result will be obtained by the introduction of magnesia or lime, or of carbonate or sulphate of magnesia, or carbonate or sulphate of lime, or calcined French chalk, or other magnesian earth, into the composition;—in which case, the following proportions will be found highly advantageous, viz., one pound of caoutchouc, half a pound of sulphur, and half a pound of magnesia, or lime, or carbonate or sulphate of magnesia, or carbonate or sulphate of lime, or calcined French chalk, or other magnesian earth. The proportions specified in both of these compounds may be considerably varied without materially changing the result; but in no case is it desirable to use a much less quantity of sulphur than four ounces to every pound of caoutchouc. With either of these compounds just described, gum-lac, or gum-shellac, may be combined to great advantage,—say, in the proportion of from four to eight ounces of gum-lac to every pound of caoutchouc. Rosin, oxides or salts of lead or zinc, of all colors, and other similar substances, both mineral

* Some curious examples of the applicability of this invention to various uses was shewn by Mr. Goodyear, in the United States department of the Great Exhibition.

and vegetable, may be added in small quantities to either of the compounds, for the purpose of imparting a polish or a suitable color thereto, and for making the mixture work more easily; but no precise rule for these additions can be given; nor, indeed, is it necessary, as the taste and judgment of the operator will be his guide in this particular.

The compounds, produced according to the above plans, are next treated in the manner to be presently described; but, as this process is equally applicable to the treatment of other compositions included in this invention, the patentee first explains of what these compositions consist. When using gutta-percha in lieu of India-rubber, the inventor takes certain proportions of gutta-percha, sulphur, and magnesia, or lime, or a carbonate or a sulphate of magnesia or lime, or calcined French chalk, or other magnesian earth, and mixes them thoroughly in any convenient manner. The proportions preferred are the following, viz., one pound of gutta-percha, six ounces of sulphur, and from six to eight ounces of either magnesia or lime, or a carbonate or a sulphate of magnesia or of lime, or calcined French chalk, or other magnesian earth. Instead of using the specified proportion of the magnesia or lime, or of the carbonate or sulphate of magnesia or lime, or of calcined French chalk, or other magnesian earth, the same proportion of any two or more of these substances combined may be employed; care being taken that the quantity of this third ingredient in the composition does not vary from the proportion of six or eight ounces. These proportions may, however, be slightly varied, without materially changing the result.

To the composition above specified, a fourth ingredient may be added, viz., gum-shellac, by which a still better article will be produced,—the body thus obtained being stronger and more easily worked. The quantity of shellac, in such case, should be about four ounces to every pound of gutta-percha.

Rosin, oxides or salts of lead or zinc, of all colors, and other like substances, both mineral and vegetable, may be added, in small quantities, to either of the above compositions, for the purposes before stated with respect to the India-rubber composition.

The compounds or compositions before described, whether of caoutchouc or of gutta-percha, may be mixed by a masticating-machine (or by any other means employed in the manufacture of India-rubber compounds), until the several ingredients are thoroughly incorporated. The mineral ingredients mixed with the caoutchouc or gutta-percha should be finely divided; and good results are produced by reducing them, before mixture, to an impalpable powder. When mixed,

the compounds are either rolled into sheets by means of calendering-rollers, for the purpose of being used in the manufacture of such articles as the same are applicable to, or formed by moulding, or other well-known processes, into any desired shape.

When thus rolled or moulded, the compounds are then to be "cured." This is effected by exposing the compound to a high degree of artificial heat,—using for this purpose either steam, hot water, or hot air. The degree of heat to which the compound is to be exposed, and the duration of its exposure, will depend somewhat upon the size or thickness of the article; but, in ordinary cases, the heat should be raised to about 260° or 270° Fahr., and the compound exposed to such heat for about four hours: as a general rule, however, it may be stated, that the heat should range from 250° to 300° Fahr., and the time of exposure from two to six hours. The compounds or compositions, by undergoing this heating or curing operation, will become of a hard and stiff character,—in many respects resembling tortoiseshell, horn, bone, ivory, and jet.

In the compounds described as compositions of caoutchouc, considerable proportions of gutta-percha may be substituted for caoutchouc, without injury; and, in the compounds described as compositions of gutta-percha, considerable proportions of caoutchouc may also be substituted for gutta-percha without injury.

Under this division of the invention, the patentee claims the treating of caoutchouc and of gutta-percha, and of caoutchouc and gutta-percha combined, as above described, for the purpose of producing a composition or compositions applicable to the various uses above set forth.

The second part of the invention refers to certain modes of applying the improved compounds to the production of various articles of manufacture. In many cases, the mode of application will be obvious, as the compositions, when hardened, may be worked like wood or bone; but, in some instances, it is proposed to mould, shape, or otherwise treat the compositions, so as to render them better suited to the purpose for which they are intended, prior to submitting them to the hardening process. Thus, when it is desired to use these new compositions in combination with common flexible vulcanized caoutchouc (as, for instance, in the manufacture of artificial jet bracelets), the parts intended to be hardened may be united to a connecting-band or connecting-pieces of flexible vulcanized caoutchouc, by cementing or pressing together the surfaces required to be joined before, the heating or curing

process has been effected: by which means, during the process of curing, the abutting elastic and non-elastic surfaces will become firmly united together.

Another plan consists in so treating the compositions, while in a plastic state, that they will harden into any desired shape. This is effected by the use of sand, pulverized soapstone, or some similar granular matter, to sustain and keep the compounds, during the process of heating, to the shape into which they were previously moulded. For this purpose, the compounds of caoutchouc or gutta-percha, before described, are taken in the green or plastic state, and cut, or pressed, or otherwise formed, into the exact shapes which it is desired they shall retain after vulcanization. The articles, thus formed, are covered with pulverized soapstone, or other similar non-adhesive powder, placed in a box filled with fine sand, or pulverized soapstone, or other similar equivalent granular or pulverized matter,—so that each article shall be completely surrounded and covered by the sand or pulverized soapstone, and imbedded in the same. When it is desired to give a very smooth surface to the article, it is completely surrounded with a layer of soapstone, even though sand may be employed about the layer of soapstone. The articles being thus properly placed in the box, the sand, or other material, is subjected to pressure, and then, by means of a cover, or sometimes by pressure, the consolidated sand, or other material, is retained in close contact with the articles so long as the process of heating continues. The articles, thus packed, are placed in an oven or heater, and subjected to the heating process before described; and, upon removing the articles from the sand or other material, they will be found to have attained the requisite hardness without losing the form which they received before being put into the sand. By this means, with a considerable economy of labor, a great variety of objects may be produced: among which may be enumerated, embossed, or indented, or plain sheets or plates, or masses of regular or irregular forms, convex or concave—such as pieces of furniture, book-covers, buttons, toys of various kinds, door-knobs, and knife-handles.

Another mode of applying the compositions consists in uniting them, in their plastic or green state, with iron, or other metals or rigid substances which will bear a high degree of artificial heat without alteration or damage. For this purpose, the article of iron, or other metal or substance which will bear a high degree of artificial heat without alteration or damage, is roughened in such portions of its surface as are intended to be brought into contact with the compound of

caoutchouc or gutta-percha, and the compound is then applied to the roughened surface of the article. When it is desired that the compound of caoutchouc or gutta-percha shall serve as a covering to the iron or other substance, a thin sheet of the compound (sometimes one thirty-second part of an inch in thickness, or less) is pressed, with great care, upon the iron or other substance, so as to expel all air from between the adjoining surfaces; and to cause the most perfect union and adhesion, the coated article is bound with strips or ribbons of cloth, or other suitable material: whereby the compound is kept in close contact with the article during the process of hardening. The combined materials, thus treated, will be found to possess the qualities desired—the iron or other substance giving strength, and the compound giving a hard and durable surface. In this way may be produced many articles used in and about harness or carriages, such as saddle-trees, buckles, terrets, bits, stirrups, martingale-rings, dasher-irons, and articles intended to be used as furniture, either in whole or in part, and a great variety of other useful objects.

When it is desired to unite these compounds with wood, the wood should be previously prepared by steaming it for several hours, or by other means, so that it shall not be warped or damaged by the high degree of heat to which it will be subjected.

Under this head of the invention, the patentee claims the completion of the manufacture of the composition or compositions, having the qualities above mentioned, after the application of the same to any one or more of the purposes indicated in the title of the patent.—[Inrolled September 1851.]

To JOSEPH RICHARDSON, of Halifax, in the county of York, dyer, for improvements in dyeing and cleansing piece-goods.—[Sealed 31st March, 1851.]

THIS invention of improvements in dyeing and cleansing piece-goods refers, firstly, to improved apparatus for immersing woollen and worsted goods (or goods containing woollen or worsted) in the dye-liquor,—whereby an economy in manual labor, as well as in the cost of the dye-liquor, will be effected; and, secondly, to an improved arrangement of apparatus for washing piece-goods after they have been submitted to the dye-bath,—the object being to expedite that operation.

In Plate II., fig. 1, is a plan view of the improved apparatus for dyeing piece-goods; and fig. 2, is a vertical section taken in the line 1, 2, of fig. 1. It consists of a shallow vessel or dye-vat *a*, supported on a framing *b*, and furnished with guide-rollers *c*, *c*, which conduct the piece-goods through the dye-liquor. Bolted to one end of the vat *a*, is a metal frame *d*, which forms a bearing for one end of the axles of the rollers *e*, *e**,—the other ends of such axles being squared and made to fit into square sockets in the bevelled pinions *f*, *f**. These pinions are carried by a frame *g*, *g*, which also serves to support a driving-shaft *h*; the rotary motion of which is communicated to the rollers *e*, and *e**, alternately, through the pinions *i*, *i**, which gear into the pinions *f*, *f**. At the bottom of the vat is a steam-pipe *k*, pierced with fine holes, through which steam is admitted into the dye-liquor, to raise it to the boiling point. *l*, is a pipe for running off the dye-liquor.

In operating with this apparatus, dye-liquor is run into the vat to a sufficient height to cover the top guide-rollers, and insure the perfect submersion of the fabric while passing through the vat. The goods to be dyed, having been sewn together in the ordinary way, to form one continuous length, are then wound on the roller *e**; and the other extremity of the connected pieces is passed over a fixed bar *m*, bolted to the top of the vat, then under the first of the guide-rollers *c*, over a second, under a third, and so on, until it emerges from the vat on the other side thereof, and passes over a second bar *m*, to the roller *e*, on which it is wound. Rotary motion is now communicated, from any first mover, through the driving-shaft to the roller *e*, which will then revolve in the direction of the arrow, and draw the fabric from the full roller *e**, into the dye-liquor, and under and over the guide-rollers,—winding it up until all the fabric has been unwound from the roller *e**. During this passage through the vat, the fabric will have become saturated with the dye-liquor; but, in order to impart to the fabric the proper color, it is necessary to subject it to several immersions. For this purpose, the rotation of the rollers *e*, *e**, is reversed, by throwing the pinion *i*, out of gear with the pinion *f*, and bringing the pinion *i**, into gear with the pinion *f**: the roller *e**, will then be caused to unwind the fabric from the roller *e*, and draw it again through the dye-liquor. When it has wound all the fabric on to its own periphery, the gearing is again shifted, and the reverse action takes place; and this is again and again repeated, until the attendant finds that a proper

shade of color has been imparted to the fabric. The proper tension of the fabric, when passing through the liquor, is ensured by a weighted cord, which is laid over a pulley on the end of the full roller, so as to act as a drag upon that roller.

From the foregoing description, it will be evident to the practical dyer that a considerable saving in manual labor is effected by the use of the apparatus; and that from the small capacity of the dye-vat, compared to those in ordinary use, much less liquor will be required than at present, to insure the proper submersion of the fabric,—and consequently the waste will be greatly reduced.

When the fabric is properly dyed, it is removed from the dye-vat, together with the roller on which it is wound, and carried to the improved washing or cleansing-machine. This machine is shewn in longitudinal vertical section at fig. 3. It consists of a large vat *a, a*, divided into three compartments by partitions *b, b*. Immediately above the vat is a series of octagonal rollers *c, c*, set equidistant from each other, and running in bearings in the outside framing; and near the bottom of the vat is another series of similarly-shaped rollers *c*, c**. The vat is supplied with water from a perforated pipe *d*, which directs it, in jets, on to the fabric, near a pair of nipping-rollers *e, e**, and thus fills the first compartment; the overflow of this compartment fills the second; and the third is in like manner filled by the overflow of the second compartment, and discharges itself by the cock *l*. The lower roller *e*, turns in bearings in the framing; and the upper roller *e**, is made to bear upon it by means of weighted levers *f, f*, which are jointed to the framing, and through their pendant rods *g, g*, communicate a downward pressure to the roller *e**. The weighting of the levers *f, f*, is effected through the rods and levers *h, i*, on either side of the machine. The roller that carries the fabric which has just been dyed, is set in bearings, provided for it, at the end of the vat; and the dyed fabric is attached to a cotton cloth, which is passed over and under the two series of rollers *c, c**, thence over a small roller *k*, and between the nipping-rollers: the lower one of which receives rotary motion through suitable gearing, not shewn in the drawing. The pulley, on the shaft of the roller *e*, is shewn connected by a strap to the apparatus employed for folding the cloth as it comes from the washing-machine; but, as this apparatus forms no part of the invention, it will be needless to describe its action.

By rotary motion being given to the roller *e*, and the roller *e**, being pressed down upon it, the fabric will be drawn forward through the water in the several compartments, and

will thus be, in great part, cleansed from the superfluous dye when it emerges from the water at the other end of the vat. It then passes over the roller *k*,—and immediately before it undergoes the pressure of the rollers, to rid it of the moisture it contains, it is submitted to a stream of clean water, issuing from the perforated pipe *d*, which completes the cleansing process. The nipping-rollers then express the water from the fabric; and it is led off from the apparatus by the roller *m*. By dividing the vat into compartments, and keeping up a continuous supply and escape of water, the cleansing operation is very expeditiously performed, and that without any great expenditure of water.

The patentee claims, First,—the means above described for subjecting woollen and worsted piece-goods, or piece-goods containing woollen or worsted, to the action of the liquor in the dye-vat. And, Secondly,—the arrangement of apparatus described for cleansing piece-goods.—[*Inrolled September, 1851.*]

To CHARLES McDOWALL, of Hyde-street, Bloomsbury, in the county of Middlesex, chronometer-maker, for certain improvements in the construction of time-keepers.—[Sealed 10th April, 1851.]

THE object of the present invention is to simplify the construction of that part of time-keepers known as the “escapement,” and thereby reduce the cost of the manufacture, and, at the same time, to ensure a more satisfactory result than can be obtained by the use of the most perfect escapement hitherto constructed. The invention is capable of being applied under a variety of forms or modifications of construction; but, in all, the same principle of action is retained, whether the invention be applied to the ordinary house-clock, an astronomical regulator, or a pocket-chronometer.* In the several forms in which it is set forth in the drawing forming part of the specification, the invention is shewn in the substitution of an excentric-pin, or a one-toothed wheel (driven by the “train”), in lieu of the ordinary “scape-wheel,” and the use of a more simple construction of pallet than that heretofore employed.

In Plate II., figs. 1, 2, 3, and 4, shew one arrangement in different positions. *A*, is the end of an arbor or axis, on which there is a pinion, driven by the clock-train in the usual way,—the numbers of the teeth in the wheels and pinions

* The exhibition of this improved escapement in the Crystal Palace obtained for the invention a Prize Medal.

being so calculated and arranged that, as the arbor A, turns once round for every two beats of the pendulum, it will allow the wheels that carry the hands of the clock to move at the required speed over the dial. On the arbor A, is fixed a small disc; from one side of which projects a short pin P, set parallel to the arbor, and revolving in a circle around it, as the arbor is made to rotate by the action of the clock-train: this disc, with the pin P, is the substitute for the usual scape-wheel. C, is an arm, vibrating on an arbor at E, parallel to the other arbors of the clock-wheels, like the usual pallet-arbor; and B, D, are the pallets, on which the pin P, acts. The pendulum is attached to the arbor E, (or it may be attached to the arm C, itself) in the same way as a pendulum is usually attached to the pallets. The proportion between the length of the arms C, and the distance of the pin P, from the arbor A, should be such that the angle of escape of the pendulum shall not exceed two degrees. By reference to fig. 1, it will be seen that the pin has just dropped from the pallet B, on to D. If the pendulum, with the arm C, is now moving to the left, it will vibrate a little farther in that direction, and the arm C, will take the dotted position of fig. 1,—the pin meanwhile resting on the upper surface of D, which is part of a circle, of which E, is the centre. When the vibrating arm returns again to this position and proceeds to the right, the pin will pass the corner of D, and come into the position shewn at fig. 2,—thereby giving an impulse to the arm in the direction of the arrow. On the arm vibrating a little farther to the right (as shewn at fig. 3,) the pin will fall off the pallet D, on to B, and rest on the lower surface of B, (which is also part of a circle, having its centre at E,) until the arm, in making its return vibration from the dotted position of fig. 3, comes again into the position indicated by the full unbroken lines of that figure. As it continues its advance to the left, the pin will, by reason of the continued rotation of the arbor A, pass the corner of B, as shewn at fig. 4, and give an impulse to the arm in the direction of the arrow,—driving it again into the dotted position of fig. 1; and then the several movements above set forth will be repeated. The action of the parts, it will be seen, is that of a dead-beat escapement. In the drawing, the impulse-pin is shewn as cylindrical; but it may be a curved tooth or cam, if required.

Fig. 5, shews an arrangement in which the pendulum is made to carry the pallets,—the vibrating arm C, being, in this case, dispensed with, and the pallets being formed by a

right-angled slot, cut in a cross-bar of steel. The action of the parts is similar to that above described.

Figs. 6, and 7, shew a modification of the invention, as applied to the balance-wheel of a watch or portable time-keeper. A, is the arbor, which communicates motion from the train, through the disc and excentric-pin *p*, to the detent-lever *c*; and this lever acts upon the roller of the balance-wheel in the ordinary manner. The lever *c*, is slotted at one end (as shewn at fig. 6,) to form the pallets *b*, *d*, on which the pin *p*, acts, to give the impulse in opposite directions, as above explained, and effect the temporary release of the pin, and allow of the required progressive motion of the train. In all these arrangements, the pin is constructed, by preference, of a ruby, or other hard precious stone, to remove all unnecessary friction; but, for the sake of economy, steel, or any other suitable metal, may be used.

The patentee states, that he does not confine himself to the arrangements above described; as it will be evident, that the objects he desires to attain may be accomplished in various ways without departing from the nature of the invention; but, whatever the modifications of form this new escapement may assume, it may (besides effecting a considerable economy in the manufacture of dead-beat escapements) be considered to possess this peculiarity, viz., that it will impart an impulse to the pendulum or balance while in the middle of its vibration, chiefly by a direct instead of an oblique action.—[*Inrolled October, 1851.*]

To BENJAMIN HYAM, of Manchester, tailor and clothier, for certain improvements in the method of fastening down trousers, or other articles of wearing apparel.—[Sealed 26th April, 1851.]

The subject of this patent is the fastening down of trousers, overalls, gaiters, and similar articles of apparel, by a band of India-rubber, or other elastic material, attached to the lower extremity thereof, and passing in front of the heel of the boot or shoe, so as to draw the back part of the trouser-leg close against the back of the heel.

In the usual mode of employing straps of India-rubber or other material for holding down trousers, and like articles, the strap is connected at the ends to the lower part of the leg of the trousers, at each side, and passes beneath the sole

of the boot. Now, according to the patentee's plan, an endless band (by preference) of India-rubber, or other elastic material, is secured, at one part, to the back of the trouser-leg, and is brought into use, for holding down the trousers, by drawing the unattached portion of such band over the heel of the boot or shoe; the band will then, by its tendency to collapse, draw the back of the trouser-leg tightly against the heel, and retain it in such position until released. Elastic straps are to be applied, in like manner, to gaiters, overalls, &c., for the same purpose.

The patentee claims the fastening down of trousers and other similar articles of wearing apparel, by the employment or adaptation of a strap of India-rubber, or other suitable elastic material, attached to the lower extremity thereof, in such a manner as to draw the back part of the same close to the heel of the boot,—the said strap acting against the front part of the heel of the boot or shoe, as above described, instead of under the sole of the boot or shoe.—[Inrolled October, 1851.]

To ALFRED VINCENT NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in cutting and dressing stone,—being a communication.—[Sealed 12th December, 1850.]

THIS invention consists in a novel construction of machinery for cutting and dressing stone,—the action of which is much the same as that of the mallet and chisel of the workman; but, from the extended surface with which the cutting parts of the machine are simultaneously brought into contact, the operation will be effected with much greater rapidity than by hand.

In Plate II., fig. 1, represents the improved machine in plan view; fig. 2, is a front elevation thereof; and fig. 3, is a longitudinal vertical section of the same. *a, a¹, a², a³, &c.*, are a series of chisels, affixed respectively in, and made to project from, the lower ends of a series of chisel-holders *b, b¹, b², b³, &c.* These holders are angular levers (see the sectional view fig. 3,) mounted loosely on a horizontal rod *d*, and rest upon a cross-bar or rest-bar *c*, which, together with the rod *d*, extends between, and is fastened firmly to, the sectoral sides *e, f*, of a frame *A*. The sides *e, f*, are formed with arcs of cogs *g, g*, and each is supported, at or near its lower end, by a journal, made to project laterally from it, as

indicated by dotted lines at *h, i*. These journals rest and turn in suitable bearings, made in, or affixed to, a main supporting frame *B*. The frame *A*, supports a horizontal cross-shaft *k*, in which the rotary hammers *l, l', l'', l''', &c.*, are fixed, and revolve therewith, whenever rotary motion is communicated to the said shaft. Each of the rotary hammers consists of a heavy block or piece of metal, with one or more striking-faces *m*, standing from it, as shewn at fig. 3. From the outer edge of the striking-face the hammer or block is gradually curved down (as shewn at *n*), to the foot of the succeeding striking-face, in case there is more than one face to each block; but, where each block has but one striking-face, the curve extends from the outer edge of the face entirely around the block to the lower edge of the face. The object of this curve is to permit the chisel-holder to be moved away from the rest-bar after each stroke of a hammer-face,—the said movement being produced in consequence of the progressive forward motion of the stone, as will be hereafter explained. On one end of the hammer-shaft *k*, a cog-wheel *o*, is fixed, which gears into a wheel *p*, mounted loosely on the journal *h*. Attached to the side of the wheel *p*, is a drum or pulley *q*, which receives motion from an endless belt *r*, that also passes around a pulley or drum *s*, fixed on one end of the horizontal driving-shaft *t*. This shaft *t*, runs in bearings *u, v*, and has a fast pulley *w*, and a loose pulley *x*, affixed to it, for the purpose of receiving an endless belt from any suitable driving power. A horizontal shaft *D*, is disposed transversely over the frame *A*, and has two pinions *E, F*, fixed on it; which pinions respectively engage with the toothed segments of the frame *A*; so that, by applying the hand to the crank-handle *G*, of the said shaft, and rotating it, the inclined or angular position of the chisels may be varied at pleasure. When they are adjusted to any required angular position, with respect to the upper surface of the stone, such position may be maintained by slipping a moveable lever or catch *H*, into one of the indentations of a notched wheel *I*, fixed on the shaft *D*.

The stone to be dressed or cut is placed on a platform *K*, which is disposed below the chisels, and is made to traverse forward, for the purpose of imparting a proper progressive movement to the stone under operation, as in other stone-dressing machines. A second set of hammers, chisels, and their operating machinery, is shewn at *L*, and is so placed, with respect to that above described, as to operate on the stone after it has been subjected to the action of the first set

of chisels. This second set differs in no material respect from the first, except in the width of the cutting chisels, and is only intended to dress or finish the surface of the stone after it has been cut by the first set of chisels. While the stone is under operation, it should be moved, as above stated, regularly and progressively towards the chisels. Previous to each blow of a hammer-face on a chisel, the projecting part of the stone, against which the edge of the chisel is to be driven, has been so moved against the chisel-edge as to press it forward on its holder in a direction off or away from the rest-bar; and then the blow of the hammer immediately forces the chisel into the stone, until the chisel-holder again meets and rests upon the rest-bar. It will therefore be evident that, when the blow of the hammer takes place, the chisel is held closely against that part of the stone to be chipped off, in essentially the same way as a workman, with one hand, usually holds a chisel against the stone, preparatory to giving it a blow with a hammer held in his other hand. No spring, or other contrivance, is employed to elevate the chisel and its stock or holder; as the mere movement of the stone against the chisel causes it to assume the proper position for receiving the blow of its rotary hammer.

The patentee claims the method substantially as above set forth, of dressing stone by a chisel or chisels, which rest on the surface of the stone to be removed at the time the blow is struck; so that the said chisel shall, by the action of the rotating hammer or cam combined therewith, be forced down until its stock is brought against the bar which determines the depth of the cut,—the feeding motion being against the edge of the said chisel, to raise it, preparatory to each successive blow, as described.—[Inrolled June, 1851.]

To CHARLES FREDERICK BIELEFELD, of Wellington-street, North, Strand, in the county of Middlesex, papier-maché manufacturer, for improvements in the manufacture of sheets of papier-maché, or substances in the nature thereof.
—[Sealed 24th February, 1851.]

SHEETS of papier-maché, of considerable thickness, have been commonly produced by causing numerous sheets of paper to be successively pasted together and dried, until the required thickness is obtained. The desired thickness of sheet has also been obtained by piling a suitable number of sheets of paper, in a wet state (as they come from the paper-mould or

sieve), one upon another, and then expressing the water by a press, and drying the sheet, so produced, whilst in a state of compression, between metal plates. Sheets of less thickness have been made by running the pulp on to a mould or sieve, having a frame thereon corresponding in depth to the thickness of sheet required, and then pressing such sheets between felts and drying them. Moulded ornaments, and other articles of papier-maché, have been usually manufactured by reducing fibrous and other matters by grinding, in a suitable machine, to the consistency of stiff dough or putty, and then moulding and drying the same.

The above remarks are made in order to point out, more clearly, the nature of this invention, which consists in rolling or pressing fibrous and other matters, ground to the state of stiff dough or putty, into sheets, and treating such sheets with oil and heat, in like manner to that in which sheets and moulded articles of papier-maché, made by the above methods, have been heretofore treated.

Either flat or roller presses may be used in carrying out this invention. The press which the patentee prefers to employ consists of a rectangular moving table, with a pressing-roller above it. The table has a rack on each side, and is supported in such manner that it may be moved to and fro at the same surface speed as the pressing-roller; for which purpose two cog-wheels are fixed on the axis of the roller, and gear into the racks affixed to the table; and the roller is kept pressed down upon the table by weighted levers. The table supports a wooden platform, somewhat larger than the intended sheet of papier-maché; over this platform is spread a sheet of moistened canvass or other suitable fabric; and upon the fabric is laid a rectangular or other frame of wood, corresponding in height with the thickness of the sheet of papier-maché which it is desired to produce. The frame is filled with the composition of papier-maché, or substance in the nature thereof, to such an extent, that considerable pressure will be necessary to reduce the same to the level of the frame. Over the composition another sheet of moistened canvass or other fabric is laid; and then the pressing-roller being caused to rotate, the table carries the platform, with the plastic papier-maché thereon, beneath the roller. The composition is passed several times beneath the roller, until it is considered to be sufficiently pressed; after which the upper sheet of moistened fabric is removed, and a flat frame or rack of wood (composed of numerous bars) is laid upon the sheet of papier-maché; then the wooden rack and plat-

form, with the sheet of papier-maché between them, are turned over; and the platform and the first-named sheet of canvass are now removed,—leaving the papier-maché upon the rack to dry. During the process of drying, the sheets are turned over from time to time; and the patentee prefers, when time and season will permit, to dry by the ordinary atmosphere in sheds, or otherwise in rooms, heated to a slight degree above summer heat: the longer the time allowed for drying, the better will be the result. The sheets, when dry, are placed in a stove, heated from 150° to 180° Fahr., and left therein until heated throughout; and they are then immersed in boiled oil, which is kept at a temperature of from 150° to 180°. The sheets are kept in the oil for a greater or less time, according to the thickness thereof and the degree of saturation desired: for sheets of one inch thick, half an hour has been found sufficient. After saturation with oil, the sheets are again dried on racks, either by the atmosphere in sheds or in heated rooms: and when they appear to be dry, they are kept for some time in a stove, heated to 180°.

The patentee states, that the above is the practice pursued by him when the sheets are to be used for forming partitions in steam and other vessels, and for panelling and other work of the cabins of such vessels, or for rooms, or the parts of railway and other carriages, and for making furniture and other structures, where it is desirable to use a material that shall be little affected by extremes of temperature.

The sheets, produced as above described, may be cut into the desired forms, and framed together in panels or otherwise; and the surfaces may be planed, smoothed, and polished, as when operating on other papier-maché; and they may be varnished without painting,—in which case various effects may be obtained by mixing colors with the fibrous materials employed; or the papier-maché may be painted and ornamented in like manner to carriage-painting. Various compositions of fibrous with other matters may be used in carrying out this invention; but the patentee prefers the following, although he does not confine himself thereto:—He makes a paste by boiling together 80 lbs. of water, 32 lbs. of flour, 9 lbs. of alum, and 1 lb. of copperas; with this paste he mixes 15 lbs. of rosin, dissolved by heat in 10 lbs. of boiled oil, adding 1 lb. of litharge; and then he adds to the mixture from 55 to 60 lbs. of dry rag-dust or other suitable fibre, and grinds the whole together. He has found that paper-makers' "half-stuff" or pulp may be used, when deprived of fluidity to such an extent that it is of a like consistency to stiff dough

or putty. When size is used in preparing the composition of fibrous and other matters, it is best to employ a hollow pressing-roller, heated by steam. In the manufacture of sheets of papier-maché by the above process, if one or both of the fabrics, which are used when pressing, be left adhering to the surface or surfaces of the sheet, instead of removing the same previous to drying, the fabric or fabrics will continue to adhere when the sheet is finished, and form part thereof.

The patentee claims the mode, above described, of manufacturing sheets of papier-maché, or substances in the nature thereof.—[Inrolled August, 1851.]

To SAMUEL WALKER, jun., of Birmingham, manufacturer, for a certain improvement or certain improvements in the manufacture of metallic tubes.—[Sealed 24th March, 1851.]

THIS invention consists, firstly, in forming skelps or sheets of metal into a tube-like form, and bevilling the edges of the same by rolling in a peculiar manner; and, secondly, in soldering the bevilled edges of the tube by means of a furnace, wherein the flame and products of combustion are conducted over those parts only of the tube which are to be soldered together.

The apparatus employed by the patentee for rolling the tubes is represented, in elevation, at fig. 1, in Plate II. The sheet of metal is first bent into a U-form, transversely; and then it is passed through the opening formed by the grooves *a*, *b*, of the rolls,—being, at the same time, supported internally by a mandril. It will be perceived that, instead of the groove *a*, being of a semicircular shape, like the groove *b*, one-half of its width forms a portion of a larger circle than the other half; and, from this peculiarity of shape, the sheet of metal will be rolled into the form of a tube, with one edge overlapping the other, in the manner shewn by the transverse section, fig. 2. The partly-finished tube is now subjected to the action of the grooves *c*, *d*, of the rolls (being supported internally, as before, by a mandril); by which it will be rolled into a perfectly cylindrical form, both externally and internally; and the edges, by the pressure exerted, will be caused to assume the bevilled shape shewn in the transverse section, fig. 3. Or, instead of rolling the partly-finished tube, the like effect may be obtained by drawing it through the dies of a draw-bench.

The bevilled edges of the tubes, produced as above de-

scribed, are soldered together by means of the furnace exhibited, in longitudinal section, at fig. 4, which is so constructed that the flame will act upon those parts only that are required to be soldered, and the remainder of the tube will not be subjected to a high degree of heat. *a*, is the fire-place, supplied with fuel through the funnel-shaped passage *b*; *c*, is the fire-bridge, having a chamber *d*, behind it; and *e*, is a passage that conducts the products of combustion from the furnace into the chimney *f*. In each side of the furnace, within the chamber *d*, there is a hole *g*, for the introduction and withdrawal of the tube to be soldered; the tube is introduced with its bevilled edges upwards, and the solder laid thereon; and then the flame and heated air, in their course from the fire-bridge to the passage *e*, act upon the bevilled edges and bring them to the proper soldering heat, without heating the remainder of the tube to the like extent. When the solder is to be applied inside the tube instead of outside, the tube is introduced through openings at a higher part of the furnace (as indicated by the dotted circle *h*), with the bevilled edges downwards, so that the flame and heated air may act thereon. If it is desired to solder several tubes at the same time, the holes should be made of the form indicated by the dotted lines at *g*.

The patentee claims, Firstly,—the forming skelps or sheets of metal into a tube-like form, and bevilling the edges of the same by rolling, as above described. Secondly,—the construction of a furnace, as above described,—whereby the flame and heated air are conducted over the part of the tube to be soldered.—[*Inrolled September, 1851.*]

To EDWIN ROSE, of Manchester, in the county of Lancaster, engineer, for certain improvements in boilers for generating steam.—[Sealed 3rd May, 1851.]

THESE improvements in the construction of boilers consist in combining the fire or smoke-flues thereof with a "multi-tubular" portion of boiler, by means of an intermediate chamber, in which the unconsumed gaseous products from the fires are consumed: whereby a saving in fuel is effected, and the escape of smoke, in a great measure, prevented.

In Plate I., fig. 1, is a longitudinal section of a boiler, constructed according to this invention; and fig. 2, is a transverse section thereof. *a*, is the external casing of the boiler, which is of a cylindrical form. At the front end of

the boiler there are two cylindrical flues *b, b*, each containing a fire-grate *c*, and fitted at the foremost end with a fire-door *d*. At the back end, the flues terminate in a chamber *e*, termed the combustion chamber, from which numerous tubes, *f, f*, extend through the hind part of the boiler to the smoke-box *g*. The chamber *e*, is strengthened and supported, at the bottom, by the stays *h, h*, and, at the top, by the stays *i, i*, and the stay-rods *j, j*. Longitudinal tie-rods *k, k*, extend from one end of the boiler to the other, for the purpose of strengthening the same. In the bottom of the smoke-box there is a passage *l*, which leads to the chimney, and is furnished with a damper or valve *m*, to regulate the draft. A small crank-arm, on the axis of this valve, is connected by a rod *n*, with a small lever at the fore end of the boiler; and thus the fire-man is enabled to open or close the valve without leaving his place before the fire-doors. The lever is retained in any desired position by a small trigger or catch upon it, entering into one of the notches in the upper part of a fixed quadrant-piece *o*, which carries the axis of the lever. The coals are supplied to each fire-place alternately, and at such times that the charge of fuel in one fire-place will be in an incandescent state when the other is being supplied with coals; and the unconsumed gaseous products from the latter, on entering the chamber *e*, will meet with the flame and heated products from the other fire-place, and thereby be consumed.

The patentee also shews two modifications of the above, constructed with only one fire-place, which is furnished with two fire-doors; and the coals are introduced through each door alternately;—the firing being so regulated that one side of the fire shall be in an incandescent state when the other is being supplied with fuel. Two flues, separated by a water-space, lead from the fire-place, and enter the combustion-chamber, in like manner to the ends of the flues *b, b*, before referred to. Through one flue the flame and heated products pass from the incandescent portion of the fire; and through the other flue the unconsumed gaseous products proceed from the part of the fire which has been newly supplied with fuel.

The patentee does not confine himself to the above details. He claims, as his invention, combining fire or smoke-flues with a multitubular portion of boiler, having a chamber between them,—whether such parts are made altogether in one boiler, or any of the parts is made separately, and subsequently united to the other parts, so as to act with them in the manner above described.—[*Inrolled November, 1851.*]

To ROBERT OXLAND and JOHN OXLAND, *both of Plymouth, chemists, for improvements in the manufacture and refining of sugar.*—[Sealed 15th May, 1851.]

THIS invention consists in the use of phosphoric acid in a combined state for defecating saccharine liquids, or solutions of sugar, and removing the color of the same.

On the 26th of April, 1849, the present patentees obtained a patent for defecating and removing the color from solutions of sugar by the employment of acetate of alumina. In the specification of such patent, lime was directed to be used for effecting the separation of the alumina; but it has been found that, even when great care is observed, some alumina is liable to be left in solution. When acetate of alumina and lime have been used, the patentees effect the removal of the remaining alumina by the use of superphosphate of alumina or superphosphate of lime, by simply adding a small quantity of either of these substances to the syrup after the completion of the process with acetate of alumina, as described in the former specification; then boiling for two or three minutes,—carefully neutralizing the excess of acid by the addition of aluminate of lime, saccharate of lime, lime water, or milk of lime; and, when it has been ascertained that alumina is completely separated, completing the process in the manner described in the former specification.

In place of using acetate of alumina, either alone or combined with phosphoric acid, as above explained, phosphates may be employed directly; and they are capable of producing similar effects to those resulting from the use of acetate of alumina, with the advantage that the whole of the agent employed is separated from the saccharine matters. In treating a saccharine liquid, or solution of sugar (say, for example, an ordinary sample of Mauritius sugar), the patentees dissolve it by blowing-up with steam, in the usual way, but avoiding the use of blood, and adding a soluble phosphate to the water employed: if crystallized phosphate of soda be used, it should be in the proportion of one pound and a half thereof for each ton of sugar. The saccharine liquid is brought to the boiling point,—any acidity being neutralized with aluminate of lime, saccharate of lime, lime water, or milk of lime; and then the syrup thus obtained (which will be of the specific gravity of from 25° to 30° Baumé) is passed through the ordinary bag filters. The sugar is, by this means, thoroughly defecated,—the feculent matters being left in the bags, from which the last trace of sugar may be removed by passing clean water through them. The weak solutions, obtained in this way,

may be used for blowing-up fresh quantities of raw sugar. As part of the color is removed from the syrup by the above-described operation, it may be considered sufficient treatment previous to boiling in the vacuum-pan, or otherwise, for crystallization; but a further amount of color may be removed by the use of from 5 to 8 per cent., or more, of hydrate of alumina (which has been dried at a temperature of 212° Fahr.), diffused through the water used in blowing-up the sugar; and, by this means, the use of animal charcoal will be rendered unnecessary. The residuary alumina left in the filter bags, after the whole of the saccharine matter has been washed out, may be dried, and the organic matter removed by ignition; and, after further washing, to remove any residuary soluble saline substance, it may be employed for manufacturing hydrate or superphosphate of alumina; or, after the first-mentioned washing, previous to ignition, it may be used over again, with the addition of a further quantity of hydrate of alumina.

When superphosphate of alumina is used, it is mixed, in solution, with the water used in blowing-up the raw sugar, in the proportion of six pounds of alumina, dissolved in phosphoric acid, for each ton of sugar; and while the syrup (at from 25° to 30° Baumé) is being brought to the boiling point, any acidity is neutralized by the addition of aluminate of lime, saccharate of lime, lime water, or milk of lime. The syrup is then passed through bag filters, and the clear syrup conducted into the receiver that supplies the vacuum or other boiling pan. The subsequent operations are the same as in the old plan of working. The matters left in the filter bags are treated as above described to remove any remaining saccharine matter.

The patentees prepare the superphosphate of alumina by dissolving alumina in phosphoric acid, in the following manner:—They burn bones white, grind them to fine powder, and digest the product in sufficient muriatic acid for the solution of the carbonate of lime only; and then they dry the residue, after carefully washing it, to remove every trace of soluble matter. To a given weight of this residue, mixed with enough water to make a thin paste (in a shallow earthenware tank or vessel), they add a quantity of pure sulphuric acid, sufficient to combine with nearly all the lime present, *i. e.*, all except 2 or 3 per cent.;—stirring the mixture well and keeping it warm (say above 90° Fahr.), for about twenty-four hours; and after this, they lixiviate the mass with water until all the soluble matters are separated from the sulphate of lime. The strong liquors, obtained in this way, may be used for combi-

ning with alumina, and the weak solutions for lixiviating fresh quantities of phosphoric acid in course of manufacture. When alumina is digested in the phosphoric acid, produced in the manner above described, phosphate of alumina, insoluble in water, is first formed; and by dissolving this in a quantity of phosphoric acid sufficient only for that purpose, superphosphate of alumina is obtained, which should be filtered previous to use.

Aluminate of lime is prepared by dissolving alumina in caustic potash or soda, and then, by the addition of lime water or milk of lime, precipitating aluminate of lime, which is to be carefully washed. When required for use, the patentees diffuse the aluminate of lime through water; and they prefer to employ it instead of saccharate of lime, or milk of lime, or lime water.

When making sugar from the cane, they defecate the juice with aluminate of lime in the usual way,—neutralizing any excess of lime with superphosphate of alumina or superphosphate of lime; then, after filtering and concentrating the filtered liquid to from 25° to 30° Baumé, they treat the syrup with phosphate of soda, in the same manner as described with respect to raw sugars; and, after a second filtration, they boil in the usual way.

In the manufacture and refining of beet-root sugar, they proceed as above described for cane sugar, only using a larger quantity of aluminate of lime or of milk of lime in the first defecation.

The patentees state that they do not confine themselves to the details above given, nor to the phosphates mentioned, as others may be substituted; but what they claim is, the employment of phosphoric acid in a combined state, as above described.—[*Inrolled November, 1851.*]

Scientific Notices.

ON BREWING AND DISTILLING, WITH AN ACCOUNT OF THE MANUFACTURE OF MALT.

As malt is the essential element of brewing and distilling, in the commercial sense of these words, it becomes necessary, before entering on such subjects, to investigate the process of malting itself, ere we can hope to elucidate, in a satisfactory manner, the complex changes which go on in those natural

laboratories—the mash-tun and fermenting-vat. This, however, unfortunately compels us to diverge still farther from the immediate subject in hand; for any attempt to describe the operations of the maltster without a previous exposition of the Excise Duty on malt, would be about as intelligible as a scientific myth. This is not the first time that we have had occasion to comment upon the vast injury inflicted by the fiscal regulations of this country upon the development of industry; nor do we altogether despair of so opening the eyes of the public to this enormous evil, that the unanimous voice of the entire nation shall demand and obtain freedom of action for the genius of our manufacturers, and the emancipation of industry from the galling fetters of ignorance and cupidity, of which the common exciseman, by reason of his mental and educational imperfections, is too commonly the personification*.

The regulations as to the manufacture of malt are embodied in the Acts 7 & 8 Geo. IV., c. 52, and 11 Geo. IV., c. 17. The former Act is an admirable specimen of legislative folly and injustice; the latter was intended to ameliorate the tyrannous provisions of its predecessor, and does, in a degree, effect that object. The first contains no less than 88 clauses; and the regulations in it, though frequently repugnant to the simplest principles of common sense and equity, are, nevertheless, enforced by 106 penalties, amounting, in the aggregate, to the incredible sum of £13,500. How much of this is negated by the subsequent Act it is not very easy to determine, though, as far as it goes, the effect of No. 2 is to

* A remarkable fact confirmatory of the correctness of our views, as to the necessity for unfettering the inventive genius of the country, has lately come to our knowledge; and we have no less satisfaction than honest pride in stating that the Board of Excise itself is now becoming a powerful witness in our favor. It will be remembered that, in our comments upon the ingenious process of Mr. John R. St. John, for the fabrication of soap, we had occasion to regret that the process in question came within the restrictive clauses of the Act, regulating the apparatus used in making soap. As, however, Mr. St. John had been awarded an Exhibition medal for this very soap, the Board of Excise found itself in a dilemma; for, either the conclusions of the Exhibition jury must be impugned, or the provisions of an antiquated Act of Parliament suspended. The latter alternative has, we hear, been most honorably chosen, and Mr. St. John has permission from the Board of Excise to manufacture soap according to his patent, though diametrically opposed to the great Soap Act of Queen Anne. Thus then the fact stands admitted by the Board of Excise, that the Act is a hindrance to the manufacture of soap, as we have all along asserted; for otherwise Mr. St. John would have required no permission to manufacture his improved soap. The discretionary power so properly exercised by the Board in this case constitutes an irresistible argument for the extension of so wise a principle, and hence we hope it will speedily be followed, as in justice it ought, by the abolition of that monster absurdity, "the Excise pump."

multify the regulations of No. 1. Woe to that man, however, who begins the manufacture of malt without having duly studied these incompatible acts of legislative wisdom. Having been privately favored with a perusal of the genuine and orthodox "instructions for officers who survey maltsters," we are able to afford a clear insight into the actual practice of the excise; for our copy is duly emblazoned with the arms of England, and marked "by authority;"—being, moreover, of so late a date as 1842, it offers unexceptionable evidence. First, however, let us review, in a few words, what may be called the natural process of malting. When healthy seeds, belonging to the orders of plants called by botanists *graminaceæ* and *leguminosæ*,—that is to say, when wheat, oats, barley, beans, peas, &c., are steeped in water for some time, and exposed afterwards in a warm situation, the process of germination commences exactly as if they had been buried in the earth by the operations of the husbandman. The grains first swell, then evolve heat and throw out small radicles or roots; at which time, the future blade may be seen shooting from the same end of the grain as the roots, but, unlike them, passing beneath the skin or husk, and in an opposite direction. This is technically called the *acrospire*; and, so soon as it has advanced to about three-fourths of the whole length of the grain, the vegetative process is suddenly put a stop to by the action of heat. The necessary apparatus for the production of malt is, therefore, extremely simple,—that is to say, a pond or trough for steeping the grain; a locality in which it might be suffered to heat and vegetate; and, lastly, a stove or kiln, in which the newly-formed malt might be dried. Specific size, or form, or other arrangement, there needs none; and such is actually the condition of the malt manufacture in most countries at this day. With us, however, a very different system prevails;—the cistern, or steeping vessel, must be of a determinate form and construction; it must have been approved of by a supervising officer; its cubical contents must have been very accurately ascertained by actual admeasurement; and it shall be placed in such a situation that the officer gauging it may have sufficient light, and a clear open space of 48 inches, at the least, above every part of such cistern, for the purpose of facilitating the process of gauging; and, lastly, if such light be an impossibility, from local obstacles, the maltster must enter into an engagement to keep, at his own expense, lamps or candles burning, for the convenience of the officer. From what we have said above, as well as from the notoriously uncertain character of grain,

it might naturally be inferred, that the process of steeping would be left entirely to the judgment of the maltster, who would determine according to his experience, and the nature of the resulting phenomena, when the grain had been steeped long enough in the water, and when it had not. The law, however, allows him no such privilege; whether the grain be old and dry, or new and moist, it is all one,—“malsters are required to keep their corn or grain covered with water for the full space of 40 hours, under the penalty of £100.” Nor will any change occurring in the appearance of the grain, and seeming to require its immediate removal, justify or excuse the maltster in so doing, unless indeed he shall have anticipated the occurrence, by giving notice of his intention to do so in his original notice “to wet”—which must date twenty-four hours previously to commencing that operation,—and given the day, and hour of the day, for beginning the steep,—all under the usual penalty of £100. Nor may he “begin to wet at any other time than between the hours of eight in the morning and two in the afternoon,” under a penalty of £100; nor may he take corn or grain from any cistern at any other time than between the hours of seven in the morning and four in the afternoon. To empty corn or grain out of any cistern until the expiration of 96 hours from the time of the last preceding emptying of any cistern in the establishment, involves a penalty of £200; and the same infliction occurs “if the corn or grain be not emptied out of all such cisterns at one and the same time, or within three hours after the clearing of the first cistern was commenced.”

“Maltsters are not to mix, either on the floor or kiln, any corn or grain of one wetting with corn or grain of another wetting, under a penalty of £100.” What is termed the couch—a place in which the grain, after being steeped, is laid together for the purpose of germination—is a supplementary apparatus of excise ingenuity, and no way necessary to the success of the malting process. Here the grain, after having been gauged in the steep, is again to be gauged with great care; and least the maltster should tread or compress the couch, so as to diminish its bulk, a penalty of £100 is imposed—though it is obvious that a power of loosening or compressing this couch, according to its temperature, would greatly improve the formation of malt. However, “all corn or grain emptied into the couch-frame is to be laid flat and level by the maltster, and so kept for twenty-four hours at the least;” and, similarly, the floors are all to be placed level, on pain of £100 fine;—so that any experimental essay at

improvement is very likely to end in the Court of Exchequer. Again, it frequently happens, or rather, we should say, it generally happens, that too little water is absorbed by the grain during the operation of steeping; the consequence of which is, that after being removed from the couch to the floor, the grain desiccates, and, ceasing to germinate, speedily evolves a sickly odour, and becomes mouldy—the incipient radicles, at the same time, drying and shrinking up for want of moisture: in fact, the grain withers and perishes from the effect of drought. This condition is very frequent about the third or fourth day from the couch, and is easily and effectually put a stop to by the application of a little water. But now comes a rather awkward dilemma for the maltster: if the grain continue on the floor without being sprinkled, it is greatly damaged, or altogether spoilt; if water be sprinkled upon it, to restore vitality, the law says, that “corn or grain, making into malt, must not be wetted or sprinkled with water before the expiration of 12 days, or 288 hours, after the same shall have been taken from or out of the cistern, under a penalty of £200.” Where, however, the steep has lasted for the full period of 50 hours, and where, consequently, the want of water is less likely to be felt, the maltster may sprinkle at the end of six days, or 144 hours; but in no case less than this,—though, as we have stated, the great urgency for the sprinkling process occurs generally on the third day; and it is an undeniable fact, that in spite of the heavy risk incurred, maltsters do almost invariably sprinkle their floors at about this period, and are thus driven to the necessity of trusting in the good faith and discretion of some favorite workmen, to the infinite injury of both parties. But the vast discriminating power confided to excise officers in these matters is positively incredible. “Whenever there shall be reason to suspect, from the *appearance* of the grain on the floor, that it has been illegally wetted or sprinkled, the officer must give immediate notice to the maltster, or his servant, of such suspicion, and make a memorandum thereof upon the specimen paper, and in the memorandum book, mentioning whether anything, and what, was stated by such maltster, or any person on his behalf,” &c. Nay, the jaundiced views of the officer are ordered to be put on record, as to an immense number of fortuitous circumstances, all of which, of course, receive an unfavorable signification: for instance, “how the kiln was loaded, and whether fed by a brisk or slow fire?—whether the house seemed in a state for running a wetting, or committing any other and what fraud?—what the trader :

says, and what character he bears in his concerns with the revenue?"—and so on, in the most arbitrary and unconstitutional spirit imaginable. Indeed, lest any doubt should exist concerning the opinion which the excise authorities entertain towards the trade in general, the officer is specially instructed to make sudden and unexpected returns or visits, at unusual periods, "which we call *doubling* on them," so as to discover any suspicious indications. Again, of the three separate gauges of malt which he may take, whether in the cistern, in the couch, or on the floor, the officer must select the largest for charging duty upon. Thus, if in the cistern he finds $78\frac{1}{2}$ bushels indicated, in the couch subsequently $81\frac{1}{2}$ indicated, and on the floor $83\frac{1}{2}$, then the latter is preferred; and so with regard to the highest wherever found—the order being, that "when the cistern or couch gauge is equal to or exceeds the floor gauge, then the best cistern or couch gauge will be the charge; but if that be less than the floor gauge, then the floor gauge will be the charge." Any accident or loss arising after the cistern gauge, is therefore thrown wholly on the maltster, who, far from being able to employ his ingenuity in the improvement of his business processes, finds himself more than fully occupied in a perpetual effort to protect his interests from the rapacious grasp of fiscal regulations, conceived in the most hostile spirit to that industry by which alone they exist. The malice, carelessness, or ignorance of a common workman may, at any moment, subject the most honest maltster in this kingdom, not merely to charges of dishonesty, but even to penal inflictions; which have ceased to carry moral degradation with them, only because of the popular belief of their gross injustice. It would be impossible, nor is it requisite, to follow out or recapitulate the innumerable annoyances to which the manufacturer of malt is subjected at present: we have thus briefly noted down a few, in order that the admirers of Bavarian and other foreign beers may take into account the very different state of the malt manufacture in this country, as compared with that brought about by an unrestricted liberty to use or apply any means which the nature of the grain, the condition of the atmosphere, or other accidental circumstances, may require during the process of germination.

Before quitting this subject, there are, however, two considerations that require notice. The first of these is the peculiarly unwise regulation of allowing no drawback of the malt duty upon exported ale or beer unless the same shall have been brewed from wort of a specific gravity of not less

than 1.054. Now, in most of our colonies, and in all warm climates, beer, to be agreeable and refreshing, should be weaker than this minimum gravity. In fact, a specific gravity of 1.047 forms by far the best beverage for exportation to a tropical country, as it is not only less heady in its effects, but ferments more kindly and completely than in a heavier wort, and when well hopped, is not liable to secondary fermentation. Nevertheless, beer of this kind, brewed in this country, and exported, suffers under the expense of the malt duty, and has to compete in the markets of our own colonies, as well as in the neutral markets of other countries, with ales brewed by American brewers, who pay no duty. The result, of course, is, that the supply of these weak beers has passed entirely out of the hands of English brewers. There is, however, good reason for believing that this impolitic regulation will be altered during the next parliamentary session.

The employment of malt in the rearing of cattle is the other consideration to which we alluded. This has been hitherto totally prevented by the excessive duty; for, though some very absurd experiments have been made with a view to decide the respective merits of malt and barley as nutritive agents, yet the only question which physiology points out as interesting and beneficial, remains without even the semblance of a trial. Malt, in a dry state, differs little or nothing from barley, except in the possession of an extremely minute quantity of a substance called diastase; but as diastase cannot exert its peculiar powers, excepting under the influence of water, and a somewhat high temperature, the only conclusion to be drawn from the experiments made in feeding cattle on malt is, that the experimentalists were profoundly ignorant respecting the most important elements involved in the investigation. If, therefore, such experiments have proved that malt is no better than its equivalent in barley for the fattening of cattle, we can only say, that this fully equals our expectation; for there can be no doubt that the heat evolved during the malting process has robbed the grain of a portion of carbon, which is, consequently, lost to the feeder of cattle. Malt cannot equal its equivalent of barley in nutritious power, unless we take advantage of the diastase it contains to render soluble, and therefore more easy of assimilation, not only its own starch, but also the farinaceous ingredients of other kinds of food. When ground malt, or a portion of diastase and water, are digested with starch, or anything containing it, at a temperature of 170° Fahr., the starch rapidly dissolves, and gradually passes, first, into gum or dextrine, and then into sugar.

Thus, for example, if potatoes be mixed with a tenth of their weight of powdered malt, and the whole subjected to the action of water, heated as above, the resulting products will be, gum and sugar in a soluble state, and, consequently, in that condition best of all suited to relieve or assist any digestive imperfection in the animal economy. Indeed, the process of digestion may then be said to have commenced, ere the food had reached the stomach of the animal; and the effects of diastase, heat, and moisture, applied externally, substitute the action of the gastric juice within. For young or sickly animals, or those whom it is desired to bring forward speedily to perfection, the use of malt, applied thus, cannot fail to ensure the most beneficial results. The nutritive powers of gum and sugar are very well known to physiologists,—the first being largely used as food by the Moors, Boschismen of Southern Africa, and the inhabitants of Sendar, in Dongolia; amongst whom “six ounces of gum are found sufficient for the daily support of an adult,” according to Jackson; whilst, in respect to sugar, it is quite notorious that, though the labor of the negroes, during the sugar season, is excessive, they, nevertheless, become extremely fat at that time, from the nutritive quality of the sugar they consume. If, therefore, it is desired to ascertain the true value of malt, in aiding the digestive powers of an animal, it is clear that this can be done only by taking advantage of the catalytic agency of the diastase it contains, and which seems so closely to resemble the animal principle “pepsine,” to the influence of which the action of the gastric juice is now almost universally ascribed by chemists. Nor would there be the slightest difficulty in carrying this improvement into practice, as most large farmers now prepare hot mashes for their cattle, though these are, for the most part, unwisely made from carrots, turnips, and such like vegetables as contain gum and sugar ready formed by nature; whereas the indication points to those of a starch kind, where the nutritive matter is insoluble, and therefore liable to pass away from the animal unassimilated. True, indeed, the malt duty offers an impediment; but the admitted suffering of the agricultural interest is a powerful instrument of honesty in a just cause, and a drawback is no novelty to the Exchequer. There is, however, an objection of a social and moral character to be urged against the malt duty, which appears to us altogether unanswerable. From what we have stated concerning the action of diastase, it must be obvious that a mixture of barley and malt would make quite as good a wort as malt alone: that is to say, one part of malt and

seven parts of barley mashed together would afford a wort exactly resembling that from eight parts of malt alone. Thus, then, by taking advantage of his scientific knowledge, the brewer might diminish his malt duty to one-eighth, or even less; but this the law will not allow, though, in foreign countries, it may be and is done, even though the difference in cost between barley and malt is but trifling in such places. But, strange to say, that which the legislature denies to the brewer, it freely accords to the distiller, who may use a mixture of malt and barley, in any proportion he pleases; thus indicating that ardent spirits are less injurious to the social status of the lower orders than beer—a perfectly untenable line of argument, but failing which necessitates the conclusion that little heed is taken of the moral sanity of the nation, so long as the vices of the people tend to replenish the Exchequer. Having thus hastily thrown together a few remarks calculated to explain the mode in which the excise duty on malt interferes with the industrial development of Great Britain, we shall now proceed to examine the operations of the brewer, and illustrate, in the language of science, the peculiar changes which occur from the mash-tun to the finished product, as “fined” for the market. First, however, let us notice the fact, that malt differs very largely indeed in the amount of its available constituents, which, by analysis, may be shewn to range from about 62 to 70 of soluble extract per cent.,—the average composition being as under:—

Moisture	6·5
Insoluble matter	26·7
Soluble extract	66·8

Now it is a remarkable illustration of the benumbing effects of excise interference, that, though these great differences exist, yet no process of analysis is adopted by any brewer of the present day, other than the uncertain indication of taste, and the still more equivocal guidance of weight per bushel,—for it cannot be called specific gravity. Therefore, although, in some of our large breweries, not less than, perhaps, 100,000 quarters of malt are used every year (a single per-centage upon which would equal the value of 1,000 quarters), yet no attempt is made, by direct experiment before buying, to determine the true worth of the article submitted for sale. The consequence of this system is not difficult to be foreseen;—in a vast majority of cases a higher price is given for bad than for good malt; and the proper yield from the mash-tun being entirely unknown, there is no possibility of determining whether this operation has been well or ill-performed. A striking

example of the errors induced by this gustatory mode of valuing malt is now before us. Of three samples, marked respectively Nos. 1, 2, and 3, the second was valued as 8*s.* better than the third; and the first as 2*s.* 4*d.* better than the second,—the estimates being those of an eminent London brewer. The following table, however, which shews their real value, as found by analysis, demonstrates the extreme incorrectness of the above method :—

		Moisture.		Insoluble matter.		Extract.
No. 1 yielded		6·8		27·5		65·7
No. 2	"		9·1		24·9	66·
No. 3	"		5·7		27·1	67·2

So that the sample reported to be the worst is actually that which affords the largest amount of extract, though it seems that No. 2 is the best malt; but, being a twelvemonth old, its content of moisture is large. The mode of estimating the true value of malt is very easy; and, but for the circumstance that brewers are afraid of the very name of chemistry, from its vulgar association with drugs, there is little doubt that, in common with every other variable article, its worth would be determined by the unerring rules of science. The day must, however, speedily come, when this coyness can no longer prove compatible with the brewing interest; and, therefore, we proceed to describe the method of executing a chemical analysis of malt. Having ground a quantity of the malt in question to powder—and, for this purpose, an ordinary coffee-mill answers perfectly—weigh out 100 grains of the powder, and expose it for half an hour to the heat of boiling water, in an oven or compartment surrounded by that fluid; at the end of this time weigh it again;—the loss indicates the quantity of moisture present in the malt. While this operation is going on, 100 grs. of the same powder are to be placed in a cup, or other vessel, with about six ounces of cold water, and then exposed to the heat of a steam-bath, with occasional stirring. This operation may continue also for half an hour, when the whole is to be thrown upon a clean linen filter; and, as soon as the wort or fluid has drained away, the residue must be well washed with boiling water; then dried and weighed. The weight represents the amount of insoluble matter; and, consequently, if, from the total weight 100, we deduct that of the moisture and insoluble matter, the remainder must represent the proportion of soluble extract, or, in other words, the saccharine value of the malt. This, as we have stated, may be taken on an average at 66 per cent.; and if we assume the quarter of malt at 324 lbs. weight, then the total saccha-

rine extract from the quarter becomes 218·84 lbs. avoirdupois; but as this, in taking on the form of gum and sugar, chemically combines with the elements of water to the extent of about eight per cent., the total weight of the extract, if evaporated to dryness, would reach very nearly 231 lbs.; and this reduced to the basis of a barrel, or 36 gallons, becomes, in the language of the brewer, 87 lbs. per barrel,—which, however, merely means, that the wort from a quarter of malt, if evaporated down to the bulk of a barrel, or 36 gallons, would weigh 87 lbs. more than a barrel of water. As a rule, 52½ lbs. of saccharine extract indicate 20 brewers' pounds, or give a barrel of wort, having a specific gravity, 1·0556 nearly.

There are some doubts as to the effect of retaining malt in a bruised or powdered state for any considerable period prior to mashing. By a few brewers this is deemed hurtful, though the majority seem to regard it as indifferent. We have made a few practical experiments on this subject, and find that, within a very extensive range, the process of mashing is rather improved than otherwise by exposing the malt to the action of the air, as, by this means, it not only attracts moisture from the atmosphere, and is thereby more easily commingled with the water in the mash-tun, but a portion of the gluten seems also oxidized by this exposure; and hence a finer and clearer wort is produced. A three months' exposure of bruised malt had not at all injured either the quantity or quality of the extract in our experiments. It might be supposed that the simplest mode of determining the value of malt would be to mash a portion with care, and then ascertain the specific gravity of the solution; but, from the circumstance previously stated, this cannot be done, as water continues to combine chemically with the extract until nothing but sugar exists, and this would require many hours' exposure to a regulated temperature; hence, the process above given is both the most exact and the most expeditious. In mashing, much depends upon the kind or strength of wort desired, as well as upon the circumstance whether table beers and strong beers are brewed in the same establishment, or merely strong beers alone. Any wort weighing, in the language of the brewer, less than 15 lbs., is, properly speaking, a table or small beer wort. The wort of the common porter, drank in this town, or London beer, weighs 20 lbs., and the strongest bottling stout is about 35. Some of the Burton and Scotch ales run, however, as high as 38 lbs. As we proceed, the means will be pointed out by which any given

sample of ale or beer may be analyzed, so as to determine exactly the weight of the wort from which it was brewed. At present, however, we must turn our attention to the wort as existing in, and flowing from, the mash-tun. In a general way, about 10 gallons of water may be taken for every bushel of malt in the first mash; and, after well mixing the two together, the whole should be closely covered down for three hours, ere any attempt is made to draw off the wort. It is immaterial whether the water be added to the malt, or the malt to the water; but the temperature of this latter is of great importance. In mild or warm weather a heat of 175° Fahr. is sufficient; but, in winter, 180° will be requisite, as the malt then cools down the average heat more than in summer. In either case, the temperature, after mixing, should not exceed nor fall much short of 170° Fahr. At the expiration of three hours, this wort may be withdrawn into a proper vessel, or underback, where it must be kept warm. Its specific gravity should be about 1.092, or weigh 33 lbs. per barrel more than water. So soon as the first wort has been withdrawn (and the quantity of which is seldom more than $\frac{1}{4}$ ths of the water employed), another portion of water must be poured upon the malt, in the ratio of about eight gallons to the bushel of malt employed, and of a temperature somewhat higher than the first. After standing two hours this is drained away, like the first, when a quantity of boiling water is slowly trickled down upon the grains from an apparatus termed a "sparger," until the wort, which flows away, ceases to possess any appreciable gravity beyond that of water. The worts are then mixed together, in these cases, where table beer is not made, and the whole reduced, by boiling, to the desired gravity of the beer meant to be brewed. Where table beer, however, is manufactured, the strong worts are kept apart, and the weak ones alone are fermented for this purpose. In both cases, the strong beers are brewed from worts having a technical weight of from 20 to 36 lbs. per barrel. It has long been supposed, that wort, as usually manufactured, consisted chiefly of sugar; but this is a great error, for there is seldom so much as one-third of all the extract in wort saccharified. The ordinary proportion is, one part of grape-sugar and three of dextrine.

For the present, want of space compels us to lay aside the pen;—this subject, and the mode of determining the relative amounts of sugar and dextrine in wort, will, however, be resumed in our next.

AGRICULTURAL IMPLEMENTS EXHIBITED IN THE GREAT EXHIBITION.

(Continued from page 487, Vol. XXXIX.)

IN our last volume, under the head of "The Industrial Exhibition," we reviewed many varieties of agricultural implements contained in the Crystal Palace, including ploughs of all kinds, digging machines, clod crushers, field rollers, harrows, cultivators and broad-cast, sowing, drilling, and dibbling machines; and as we have reason to know that our labors have not been altogether unappreciated by the class of readers to whom our remarks were more particularly directed, we now propose to complete our review of this important department of the Great Exhibition, by the publication of some supplementary papers, which will bring under notice those kinds of implements not yet treated of in our Journal.

HORSE-HOES.

Horse-hoes are implements designed to effect, by horse-power, the loosening of the earth and cutting up of weeds between the rows or drills of growing crops, in lieu of performing such operations by hand. They appear either as simple implements, suited to work between two adjacent rows of root crops, sown either upon the ridge or flat, or as machines, adapted to work between several rows of grain or root crops, simultaneously. The former are made with a beam and handles, similar to a plough; to this beam, and to side bars attached thereto, the hoes or tines are secured; and the fore end of the beam is generally fitted with a guide-wheel or wheels, to regulate the depth to which the hoes shall penetrate into the soil. The other implements are of a more complicated character, and contain a much larger number of hoes, which are connected to the frame in such manner as to admit of the same being guided with great precision, independently of the movements of the horse, in order to prevent any injury to the plants between which they are working.

A horse-hoe, of the first class, for ridge work, was included in the award of a Council medal to Mr. Busby. In this implement a triangular share is affixed to the beam; and behind it are two bent knives or tines (curving inwards), carried by arms attached to the sides of the beam. To the heel of the beam a small Norwegian harrow, consisting of two sets of rOWels, is connected, for the purpose of clearing the soil from

the roots of weeds, and leaving them on the surface to wither. Mr. Busby also exhibited a stronger implement, of like construction, with five tines; and one with the side-arms, which carry the tines, jointed at their fore ends to the beam, so as to admit of being expanded to suit drills of different widths.

Messrs. Hill and Co., of Dudley, exhibited an expanding horse-hoe, for turnips, potatoes, &c., having a share (the cutting edge of which is nearly semicircular) attached to the beam, two bent knives on the side arms, and a Norwegian harrow at the heel of the beam, similar to Mr. Busby's hoe. In the implement under notice, the knives can be expanded to any required width without stopping. For this purpose, each arm is jointed at the fore end to a curved cross-piece on the beam; at the centre it is connected by a link-rod with the fore end of one of the handles; and from the hind end (which carries the knife) a small bar, pierced with several holes, extends through a slot in the handle, and is fixed thereto by inserting a pin in one of the holes. It will therefore be evident that, by moving the handles to or from each other, a corresponding movement will be imparted to the knives.

Mr. Comins, of South Molton, gained a prize medal for a horse-hoe. To the fore part of the beam is affixed a triangular share; and behind this share are four double arms, projecting horizontally from the beam,—each arm being bent so as to form a slot along it to receive the stem of a tine or hoe, which has a shoulder to fit against the under side of the arm, and is screwed to receive a nut above: this arrangement admits of the stem being readily shifted along the slot, either to or from the beam. The arms are placed one before the other on alternate sides of the beam; the two foremost ones are the shortest, and carry two curved tines; and the two hindmost ones carry two bent hoe-blades, pointing inwards.

A useful ridge-hoe, made by Mr. Bentall, of Heybridge, upon the principle of his broad-share, scarifier, and subsoil plough, is described at p. 287, Vol. xxxix.

Mr. Harkes, of Mere, near Knutsford, Cheshire, contributed a parallel expanding horse-hoe, capable of being set to any required width without stopping the horses. The side bars are jointed to the opposite ends of two double parallel levers, which are pivotted at the centre to the beam; and the right-hand end of the hind lever is connected by a rod with a lever that turns upon a pin carried by one of the handles: which handles are fixed to the heel of the beam. By means of the last-named lever, the parallel levers can be made to

turn on their pivots in either direction ; and according to the direction in which they move, so will the side bars be caused to approach to or recede from the beam. A triangular or double-winged share is attached to the beam ; and to each side bar is affixed a single-wing share (with the wing pointing inwards) and, just before it, a straight inclined blade or coulter. The hind ends of the side bars are furnished with small wheels, which, with the wheel at the fore end of the beam, regulate the depth that the shares shall penetrate into the soil.

An expanding horse-hoe, exhibited by Mr. Barker, of Dunnington, is formed with a parallel-motion frame like the preceding implement ; but, instead of this frame being moved by a lever, the rod connected to the hindmost lever is screwed at the end, and works in a nut affixed to a winch handle, which is capable of turning in a bracket on the cross-bar that connects the handles ; so that when the handle is turned, motion is transmitted through the rod to the frame, and the shares are expanded accordingly.

Messrs. Ransomes and May had an expanding horse-hoe, the side bars of which were jointed at the fore end to the beam ; and from the hind end of each bar a small perforated bar extended to the beam, and was secured thereto by the insertion of a pin. The beam carried an upright knife and a semi-circular share ; and to each side bar three straight knives and a triangular share were affixed.

A horse-hoe made by Messrs. Gray and Sons, of Uddingston, consists simply of an iron beam, fitted with a pair of handles at one end and a guide-wheel at the other, and carrying three shares. The foremost share is a double-winged one. The two others are single-wing shares, the stems of which have small arms, projecting horizontally therefrom at right angles, and passing through corresponding openings in the beam, formed one before the other.

Messrs. Wedlake and Co., exhibited a horse-hoe, of a similar character to the above. The beam and handles are of wood ; the foremost share is made with a semicircular cutting edge ; and the two others are fixed, parallel to each other, to a transverse iron bar at the heel of the beam, and secured thereto by screws and nuts, in such manner that they may be adjusted laterally.

A horse-hoe was exhibited by M. Le Docte, of Henge, Belgium. This implement consists of a wooden beam, with a pair of handles at the hind end, and a wheel at each end. To the fore end of the beam two side bars are jointed ; and they

are adjusted to the required degree of divergence by fixing them by set screws to an iron bar, that extends through the beam and through the side bars. The beam carries a triangular share, and a curved tine behind it; and to each of the side bars two curved tines are attached.

We come now to speak of the second class of horse-hoes, consisting, as before stated, of implements which are of a more complicated character than those already noticed, and are suitable for stirring the earth and destroying the weeds between several rows or drills at the same time. Of this class, the machine exhibited by Messrs. Garrett and Son was included in the award to them of a Council medal. The frame of this machine runs upon two wheels, and is furnished with a pair of shafts for the horse. The hoes consist, severally, of an upright stem, carrying at its lower end a steel blade, which stands at an angle to the stem in a horizontal plane, and with its cutting edge at an acute angle or inclination to the surface of the land; or, in place of this blade, the stem carries one which has an edge of nearly a semicircular form. The blades are attached to the stems by screw-bolts and nuts, and can therefore be readily replaced when worn. The hoes are keyed to weighted levers, similar to the coulter of a drill; which levers are jointed at the fore end to a horizontal bar, suspended like the lever bar of the drill before described; and the hind ends of the levers work between guards or guides (to keep them in position) carried by a bar which is suspended beneath them by two chains from excentric pulleys. When it is desired to raise the hoes, the pulleys are caused to turn and wind the chains partly around them, by means of a lever affixed to the axle whereon the pulleys are mounted. It is fitted with a "steerage," of the kind before explained in the description of the drill, whereby the hoes may be guided with great exactness between the rows of corn or plants, so as to perfectly destroy the weeds and loosen the earth between them, without in the slightest degree injuring the corn or plants. The wheels of the horse-hoe should be set the same distance asunder as the wheels of the drill used in drilling the grain or seed, so as to work in the same track; and, in order that the same horse-hoe may be used after drills of different widths, the axles of the wheels are made to shift endwise. For this purpose, each wheel is mounted on a short axle or pin, projecting from a metal bracket of an angular form, thus ; the long horizontal part of which extends through a staple on the under side of the back rail of the frame; and it is retained in its place by a bolt, passed through it and through a long slot

in the rail. This bolt, on its tightening nut being loosened, can be moved along the slot in either direction; and thus the axle-bracket may be shifted inwards or outwards, as required. Messrs. G. and Son's apparatus for sowing clover and rye-grass broad-cast (before described) is frequently applied to the front part of this horse-hoe, and fitted with conductors, which terminate, at about six inches from the ground, in flat wide mouths, so as to scatter the seeds effectually between the drills; and, by the action of the hoes, the surface is afterwards broken up or pulverized and the seeds covered.

In a horse-hoe contributed by Messrs. Crowley and Sons, of Newport Pagnell, the stems of the hoes are attached to weighted levers, which are connected, at the foremost ends, by a double joint, to the horizontal front bar of the framing, in such manner that they can move sidewise as well as up and down. Each lever is kept in its proper position (when adjusted) by a rod, extending vertically through a slot in it, and secured by sockets and set-screws, at top and bottom, to two horizontal rods, which are attached to the back part of the framing. The hoes are raised from the earth by means of two chains and semicircular pulleys, in like manner to the hoes in Garrett's implement. The frame of the machine runs upon a pair of wheels, and is fitted with a two-wheeled fore-carriage, which is caused to turn around an upright pin (carried by the front bar of the frame) by means of handles, which extend to the back of the machine.

The steerage horse-hoe, made by Mr. Smith, of Kettering, is a useful implement, of a less complex nature than the foregoing, and therefore recommends itself, on the score of economy, to the notice of small farmers. The hoes are attached to two transverse iron bars, set parallel to each other, and constituting the frame of the implement. To the front bar two light iron rods are fixed, having eyes at their foremost ends, which serve to connect them to two hooks on a two-wheeled fore-carriage; and the back bar is furnished with a pair of handles, whereby the attendant can guide the hoe-frame with accuracy, independently of the movements of the horse in the shafts of the fore-carriage. The hoes are secured to the transverse bars by means of clips, that partly embrace the bar, having a hole in each end, for the stem of the hoe to pass through, and at the back a set-screw, that presses against the bar: these clips can be shifted along the bar, in order to set the hoes at any desired distance asunder. The wheels of the fore-carriage can be placed nearer to, or further from, each other, as the horizontal bars, that carry the axle-arms, slide in bearings; and, when adjusted, they are fixed

by a screw-clamp, that embraces both bars,—the bars, for this purpose, being made of such length as to extend across some distance beyond the centre of the fore-carriage. Mr. Smith also exhibited a horse-hoe of like construction, but with only one transverse hoe-bar,—to which, consequently, both the connecting-rods and the handles were fastened.

Mr. Grounseil's horse-hoe consists simply of a wooden frame, mounted on two wheels, and furnished with shafts for the horse, and, at the back, with a pair of handles, by which the attendant guides it. To the back bar of the frame is affixed a flat iron bar, with three parallel rows of longitudinal slots therein, through which the upper ends of the hoe-stems pass, and are secured by screwing nuts on to them above the bar.

HAND-HOES.

The term "hand-hoes," legitimately includes all implements for hoeing which are worked by hand; but we purpose only, under this head, to notice a few implements which somewhat resemble horse-hoes in construction, but are actuated by manual labor.

A hand-cultivator and drill-hoe, exhibited by Dr. Newington, is an efficient implement, adapted for stirring and hoeing land. It consists of a long rod or stem, with a cross-handle at the top, and at the bottom a forked piece, to which two transverse bars, that carry the tines or hoes, are bolted. These bars are of unequal lengths,—the shortest preceding the other; and in each a longitudinal slot is formed, to receive the stems of the tines, which are made with a shoulder to fit beneath the bar, and receive a nut above. One tine is secured to the front bar, and two to the hinder one; and, by being fastened in the manner described, they can be moved along the bars to suit the spaces between the drills. If the implement is to be used for stirring or cultivating the land, only plain tines are attached to the bars; for hoeing, small double-wing shares are fixed on to the lower ends of the tines; or, by the addition of suitable fittings, it may be rendered suitable for drawing furrows and earthing-up potatoes.

Amongst the implements exhibited by Mr. Warren, of Heybridge, there was a hand-hoe, composed of a light iron frame, carrying three hoes or shares, whereof the centre one was double-winged, and stood in advance of the side shares, which had single wings, pointing inwards. The frame was mounted on a pair of small wheels; and, from the front of it, two bars projected, and were united by a cross-bar or handle.

In the Belgian department, M. D'Omalus had a hand-hoe. The frame is composed of two parallel longitudinal wooden

bars, standing about four inches apart, and connected together by iron fastenings. The front end of the frame is supported by a pair of small wheels; and, at the back, it is furnished with a pair of handles. To each longitudinal bar a small hoe is secured; and, between the two hoes, there is a springing piece of metal, consisting of a horizontal strip of iron, affixed, at the foremost end, to the frame, and having, at the hind part, which is left free, a portion bent downwards at each side: thus .

MANURE-DISTRIBUTORS.

The portable apparatus employed for distributing manures over the land resolve themselves into two classes, viz., those for scattering or sowing manures in a pulverized state, and those for delivering liquid manures. The former bear some resemblance to the machines for sowing seeds broad-cast; and the latter may generally be likened to watering-carts. The broad-cast manure-distributors are employed with advantage for applying pulverized manures in the spring to autumn-sown wheat, and for dusting lime over wheat infested with the slug, or turnips attacked by the fly. Liquid manure is delivered over the land in a similar manner to the operation of watering; and the apparatus used for this purpose should be so constructed as to ensure a regular and even distribution of the same.

Dr. Newington obtained a prize medal for a hand implement, to be employed for distributing pulverized artificial manures, either broad-cast or in rows. This implement is constructed in like manner to the manuring portion of the same exhibitor's horse-drill or seed and manure depositor, before described. The hopper for containing the manure is mounted on a pair of wheels, and fitted with a handle, by which it can be drawn onward. It is provided with a plate, to regulate the size of the discharge-opening, and apparatus for ensuring a regular delivery, actuated by crown-wheels, with triangular or wedge-shaped teeth, as in the before-named machine.

A machine for distributing artificial manures, either broad-cast or in rows, was exhibited by Messrs. Holmes and Sons. The implement travels upon a pair of cart-wheels, and is drawn by a horse. The manure-box is divided longitudinally into two compartments, from the upper of which the manure gradually descends through openings, regulated by slides, into the lower one; and, in the latter, there is a series of stirrers, affixed to a horizontal spindle, to which a lateral as well as a rotary motion is given, to ensure a regular supply of manure

to the deliverers. These are two flat boards, fixed across the back of the machine in an inclined position, one above the other, so as to form a broad inclined passage, divided by other boards, which extend in angular directions from top to bottom of the same; and down these divisions the manure descends from the stirrers to the earth. When the manure is in a moist state, rappers or cleaners are placed upon the spindle, for the purpose of acting on the deliverers, and preventing the manure from adhering to them.

The liquid manure distributing cart, of Messrs. Reeves, is constructed with a manure chamber similar to that of the drill described at p. 474, Vol. xxxix.; and in like manner such chamber is provided with several endless moving chains; but, in place of each chain carrying a separate set of small buckets, long troughs, which extend across the chamber, are attached to the chains. These troughs, as they successively arrive at the top of the cart, throw the liquid manure on to sloping boards, whence it falls on to the land.

Mr. Crosskill exhibited a liquid manure cart, closely resembling, in general appearance, the common water-cart. In place of the liquid manure being distributed by passing over an inclined board at the tail of the cart, before it descends to the earth, it is discharged through a pendulum-spreading apparatus, which is adapted to distribute the manure equally over land with an uneven surface. This apparatus consists of a tube, formed with a row of small openings on the under side (which can be adjusted in size by a regulating slide) and suspended from a pivot at the back of the cart, so as to be capable of maintaining a horizontal position when passing over uneven land. With the fixed spreading board, when the cart travelled over a sloping surface, the liquid flowed to the lowest part of the board, and was therefore distributed irregularly; but this is remedied by the pendulum-spreading apparatus. The cart is rendered suitable for delivering liquid manure to four rows of turnips, by the application of a box-trough and four India-rubber tubes, which are guided by two boys, with a handle in each hand. The body of the cart is made of iron plates, connected and bolted together; it is fitted with a brass outlet valve, which the driver can open and close by means of a lever, while he is walking by the side of the horse; and there is a partition across the inside of the body, to prevent the liquid surging and overflowing on rough land or bad roads.

Mr. Coode, of Oxford-street, exhibited irrigators for supplying liquid manure to grass land or low crops, and also to high-standing crops,—the implements in the former case

being worked by hand, and in the latter by horse-power. We shall confine our remarks to the last-named irrigator, which consists of a long hollow tapering bar of wood, pierced with small holes throughout the greater part of its length, and supported in a horizontal position by two wheels,—one at the large end where the liquid enters the tube, and the other at about one-third the length of the tube from the opposite end. The tube is fitted with a pair of shafts for the horse, whereby it is drawn over the land; and at the large end there is a rotating reel, carrying a long length of hose, which connects the tube with the tank or pump that supplies the liquid manure. As the tube moves onward, it delivers the liquid in numerous small streams; when it arrives at the end of the length of hose, a fresh length is connected to the former; and this is repeated until it reaches the end of the field;—suitable means being adopted for stopping the flow of liquid at such times.

In the Netherlands department there was a liquid manure-distributor from Mr. Stam, of Bennebroek, near Haarlem, consisting of a rectangular wooden box or tank, mounted on four wheels. Through a hole in the lower part of the back the liquid manure flows on to an inclined plane, by which it is distributed over the land: the distributor not only slopes backwards towards the earth, but it also inclines from the centre thereof towards the sides. This was the only example of manure-distributors contained in the foreign departments of the Exhibition,—a fact not easily to be accounted for, when it is remembered how extensively liquid manure is employed upon the Continent.

PATENT LAW REFORM.

IN order to satisfy, if possible, the natural curiosity of inventors and patentees respecting the change in the practice of granting patents, consequent on the coming into operation, on the 1st of January, 1852, of the Act of last Sessions, "To simplify the forms of Appointments to Offices, &c.," we have delayed publishing to the last moment, with the view of ascertaining what alterations have been decided on as to the fees to be paid on future grants; but, up to the time of going to press, nothing definite has been arranged. We hope, however, to be able, in our next number, not only to announce the fact of a reduction in the cost of patents having taken place, but also that some reforms in connection with the preliminary stages of these grants have been effected.

INSTITUTION OF CIVIL ENGINEERS.

November 25, 1851.

SIR WILLIAM CUBITT, PRESIDENT,—IN THE CHAIR.

The paper read was "*On the application of machinery to the manufacture of rotating chambered-breech fire-arms, and the peculiarities of those arms,*"—by COLONEL SAMUEL COLT, U. S. America.

The communication commenced with an historical account of such rotating chamber fire-arms as had been discovered by the author, in his researches after specimens of the early efforts of armorers for the construction of repeating weapons; the necessity for which appears to have been long ago admitted.

The collections in the Tower of London, the United Service Museum, the Rotunda at Woolwich, Warwick Castle, the Musée d'Artillerie, and the Hotel Cluny, at Paris, as well as some ancient Eastern arms, brought from India, by Lord William Bentinck, demonstrated that early efforts had been made to produce arms, capable of rapidly firing several times, consecutively, without the delay of loading after each discharge. Drawings of these specimens were exhibited, comprising the match-lock, the pyrites wheel lock, the flint-lock, down to the percussion lock, as adapted by the author.

Among the match-lock guns some had as many as eight chambers, rotating by hand; and the length of the chambers, as well as the thinness of the barrel, proved the bad quality of the gunpowder at the period of their construction.

Some of the pyrites wheel-lock guns had also as many as eight chambers, and rotated by hand; one of them, made in the 17th century, had the peculiarity of igniting the charge close behind the bullet, burning backwards towards the breech; an arrangement identical in principle with that of the modern Prussian "needle gun," for which great merit has been claimed.

The flint locks induced more determined efforts, but all were abortive, as the magazines for priming, and the pan covers were continually blown off on the explosion of the charge. Indeed, from the earliest match-lock down to the present time, the premature explosion of several chambers, owing to the simultaneous ignition of the charges, from the spreading of the fire at their mouths, had been the great source of difficulty. In some of the most ancient specimens, orifices were provided in the butt of the barrel for the escape of the bullets in case of explosion, whilst others had evidently been destroyed by this action. In a brass model of a pistol of the time of Charles the Second, from the United Service Museum, there was an ingenious attempt to cause

the chamber to rotate, by mechanical action, in some degree similar, but more complicated, than the arms constructed by the author.

The "Coolidge" and the "Collier" guns, both flint guns of comparatively modern manufacture, exhibited the same radical defects, of liability to premature explosion.

The invention of Nock's patent breech, and the Rev. Mr. Forsyth's introduction of the detonating, or percussion gun, which latter principle, with the necessary mechanical arrangements for the caps, was essential to the safe construction of repeating fire-arms, constituted a new era in these weapons; and the author recognizing the peculiar wants in a country whose inhabitants were constantly moving onwards towards new settlements, where the pioneers were required to protect themselves and families, by their personal prowess, frequently against fearful inequality of numbers, from the attacks of the aboriginal Indians, whose peculiar mode of warfare could only be coped with by rapid and repeated firing, it was natural that attention should be directed to the production of self-acting repeating arms.

The author, being fully cognizant of these wants, but entirely unaware of any previous attempts to produce such weapons, made a series of experiments on skeleton fire-arms, which were very successful; but subsequently he fell into many of the errors of his predecessors, for, from the breech and the mouths of the chambers being more or less covered, simultaneous explosion of several charges constantly occurred. This induced the restoration of the arms nearly to their original skeleton form, and the result was the production of the present arm, which has been so universally adopted in America, that the author's large manufactory has proved quite insufficient to supply the demand.

The means for manufacturing these arms on so large a scale, was the main point of the paper; for, unlike the system adopted in England and on the continent, of making fire-arms almost entirely by manual labour, the several parts comprising these weapons are forged, planed, shaped, slotted, drilled, tapped, bored, rifled, and even engraved by machinery, to such an extent that 10 per cent. only of the value of the arm was for hand labour in finishing and ornamenting; 90 per cent. being executed by automaton machines, guided by women and children, whose labour was represented by 10 per cent., leaving 80 per cent. for the machinery.

The action of these machines was described; and it appeared that though, like a cotton or flax mill, the manufactory, at first sight, appeared intricate, yet that each part travelled independently through its course, until at length the finishing workmen had only to put the several parts together, almost indiscriminately, and the uniformity was so precise that little or no fitting was required, beyond removing the "burr" or rough edge left

by the machines. This was a point of great importance, especially in a country of such extent as America, where the necessity for sending arms from one district to another for repair, might be attended with serious consequences.

The arms now manufactured by the author, and of which numerous specimens were exhibited, were of the simplest construction; the lock consisted of only five working parts contained in a lock-frame, cut out from the solid metal, into which the breech arbor was firmly inserted, and by it rigidly attached to the barrel, in such a manner as to regulate, with the greatest precision, the contact between the end of the barrel and the mouths of the cylinders, so as to prevent any serious escape of lateral fire.

The rotation of the cylinder was accomplished by a self-acting lever, to which motion was given by the act of drawing back the hammer. At half-cock the cylinder was free to rotate in one direction, for the purpose of loading and putting the caps on the nipples; the former operation being rapidly accomplished by the conversion of the ramrod into a jointed lever, attached to the barrel, by which means the bullets were rammed home so securely, that no patch or wadding was required. The grooves in the barrel were of a peculiar spiral, commencing almost straight, near the breech end, and terminating at the muzzle in a curve of small radius. The bullets were either of cylindrical or conical shape; and from some diagrams of several practice targets sent from Woolwich, by Colonel Chalmers, R.A., for exhibition at the meeting, it appeared, that even by men unaccustomed to the use of this particular arm, great precision of firing could be attained, as with a small revolving belt pistol, at a distance of fifty yards, out of forty-eight shots, twenty-five bullets took effect, within a space of one foot square, and of them, thirteen hit the bull's-eye, which was only 6 inches in diameter; the whole number of shots striking the target.

This was the first American communication that had been brought before the Institution, and it was received with acclamation; and in the discussion which ensued, in which the Honorable Abbott Lawrence (United States Minister), Captain Sir Thomas Hastings, R. N., Captain Sir Edward Belcher, R. N., Captain Riddell, R. A., Mr. Richards, Mr. Miles, and the Members of the Council, took part—the most flattering testimony was given of the efficiency of the Colt Revolvers in active service, and the strongest opinions as to the necessity of their use in all frontier warfare; and that without this arm it was almost impossible, except with an overwhelming force of troops, to cope with savage tribes.

From the diagrams on the wall, and the ancient arms exhibited, it appeared, that the desirableness of obtaining repeating arms, had been admitted from the earliest period of the use of gunpowder; but all the attempts at constructing them usefully had

been frustrated by certain mechanical deficiencies, which Colonel Colt had, after long trials and experience, succeeded in remedying. It appeared also singular, that many of the modern repeating arms contained most of the fatal errors of construction, so clearly shewn in the paper, to have prevented the proper action of the ancient arms, and that nothing but long experience on active service could have enabled Colonel Colt to discover those errors, and to adopt those changes, minute and simple as they might appear, which had finally produced so effective an arm.

2nd Dec. 1851.

The discussion on Colonel Colt's paper was renewed; the Honorable Robert J. Walker (late Secretary to the U.S. Treasury), General McNeill, and other visitors, taking part in the discussion. The processes of the manufacture were also described, and the importance of machinery in a country like America, where labour was so dear, was clearly shewn.

The machines employed were too numerous to be particularly described; but it appeared that slowly rotating rose cutters were the chief tools used, the various pieces being held up to the tool, and presented in different directions to the required cutting action, almost without any intervention of the workman, after being brought under the action of the machine. For instance, the lock-frame, after being centered, passed through twenty-two machines before it was completed, and all the operations had reference to the arbor, or centre pin first inserted. The same took place with other parts; and such a degree of uniformity was arrived at, that the thirty thousand arms constantly in progress of manufacture in Colonel Colt's works, were put together from pieces taken promiscuously from the mass. This advantage of uniformity was very beneficial in active service, as seventy, or eighty per cent. of serviceable arms could be made up from those injured in action.

In the course of the discussion it was observed, that the present object of all enlightened Americans was to promote intercourse between their country and this, their Fatherland,—and that this would be more aided by the labours of Civil Engineers than by any other class of men. That in the United States, though there was a less amount of high acquirement among the engineers, there was a greater amount of sound education and ingenuity among the working mechanics, than generally existed among the same class in this country.

The aid of English Civil Engineers was claimed in the great attempt to traverse the Isthmus of South America by a navigable ship canal, for which the American engineers were the pioneers, with the railway now in course of execution;—and in paying a graceful compliment to the attention to American engineers on

the part of Telford, and his successors in the profession, it was stated, that almost every English engineer, of any talent, who had gone to the United States, even in however humble a position, had, in a few years, attained eminence and fortune.

The influence of Colonel Colt's arms in the late wars in Mexico, was again flatteringly alluded to, and the ingenuity and perseverance exhibited by him, in the formation and conduct of such an immense armory, were highly eulogised.

December 9, 1851.

THE paper read was "*An Account of the Works on the Birmingham Extension of the Birmingham and Oxford Junction Railway,*" by Mr. C. B. LANE, Assoc. Inst. C.E.

The Act for this line, which was intended to form the connecting link between the Birmingham and Oxford, and the Birmingham, Wolverhampton, and Dudley Railways, and so complete the broad-gauge circuit with Bristol and the south-west of England, was passed in the month of July, 1846. Subsequent events, however, caused the suspension of these works in 1849, before their final completion. The line commenced near the Coventry road, and was to have terminated at Great Charles-street. From Adderley-street to Park-street, both inclusive, the town was crossed by a viaduct; and from Moor-street to Monmouth-street, the line passed under the highest of the eminences on which Birmingham stands, by means of a tunnel, which was to have been constructed as a covered way; that is, by opening the ground, putting in the brick-work, and again covering up; and the part of it as yet completed, from Moor-street to High-street, being about 142 yards in length, was executed in this manner. It was 27 feet in width at the level of the rails, and was built entirely of Staffordshire brick, set in mortar, with the exception of the arch-lengths through Carr's-lane, which were set in cement. The average rate of progress in the tunnel was 8.1 lineal yards per week.

The viaduct consisted of fifty-seven openings, composed of nine segments, each 30 feet span, and 6 feet rise; fifteen semicircles, also 30 feet span, and 15 feet rise; twenty-seven semi-ellipses, each 15 feet rise, and varying in span from 37 feet to 48 feet; and six street-bridges, mostly skew, and varying in form, span, and rise. Its total length was 930 yards; general width, from face to face, 31 feet 7½ inches; and between the parapets, at the level of the rails, 29 feet. It was built entirely of brickwork, set in mortar, with the exception of the soffit of the bridge over Park-street, which was constructed of cast-iron girders, with a cross-transomed Mezel flooring. The red brick of the district

was used throughout the footings, the internal work of the piers, and the spandril walls; the arches and parapets were constructed of Staffordshire brick, from the "common stock"—the copings, mouldings, and dentals being made of Staffordshire brick-clay; and the whole of the work was faced with Staffordshire "best blue." All the brickwork was set in moist mortar, so as to press to a thin joint, and in hot weather the bricks were kept constantly wet. The mortar used in the work was composed of the red sand of the locality, and Dudley or Greaves' blue lias lime—the latter being used in all foundations, arches, and face-work—mixed in the proportions of one part of slaked lime to two parts of sand, and worked by a steam-mill, driven by a four-horse-power engine, made by Mr. Nathan Gough, Assoc. Inst. C. E., of Manchester. This mill was capable of supplying fifty bricklayers per day, with a mortar of a perfectly even texture, entirely free from lumps, and therefore less likely to become vesicular, from the trans-filtration of water, than that mixed by the common pug-mill. Each set of centres consisted of five ribs, each rib being supported on two vertical and two sloping props, the former under the heels of the ribs, and the latter under the points where the struts of the ribs terminated in an iron shoe. The laggings used were three-inch deals, carefully dressed by the adze to the proper curves, and lined for the courses of the skew arches. Corbels of heading bricks were carried out from the backs of the arches in the range of the spandril walls, of equal width with them, and connected by brick beams from arch to arch, for stiffening and equalizing the pressure from end to end of the viaduct; and the useful effect of this mode of construction was proved by the comparatively small amount of the settlements of the arches.

The paper gave a particular description of the different works, for the drawings illustrative of which the isometric projection had been chiefly adopted, and the sections taken so that every dimension might be obtained; orthographic sections of the details were added, in some cases, in order to render the various parts more distinct. These drawings were made by the author's pupils of the first year, in the engineering class of Queen's College, Cork.

The various modes adopted, and mechanical contrivances used, for raising the materials to a considerable height, were described; and deductions were drawn from a very numerous series of experiments, to ascertain the values for the useful effect produced by the "Labouring Force" (Whewell), or "Travail Mécanique" (Poncelet), of a man under different modes of its application, and also for a horse under alternating motion over a short space. From these it appeared, that the relative costs of raising the materials to a height of 46 feet, by the horse-lift, the swing-lift, and the box-lift, were 3·08, 5·90, and 4·13 pence per ton re-

spectively, shewing a saving in favor of the horse-lift against the swing-lift, of nearly threepence per ton,—against the box-lift of rather above one penny per ton.

The communication was accompanied by an elaborate series of tables on the absorption of water by bricks, by mortar, and by Shrewley sand-stone,—of the settlements of the arches of the street bridges,—of the work performed by the various lifts, under different circumstances, with the concurrent particulars, and that by ordinary hod-men.

SOCIETY OF ARTS.

IN accordance with a suggestion made by His Royal Highness Prince Albert, the Council of the Society has made arrangements for the delivery, by gentlemen of acknowledged talent, of a series of lectures in the several branches of practical science, with the view of illustrating the bearing of the Great Exhibition on the progress of the industrial arts. In conformity with this plan, the Sessions was commenced, on the 26th November, with an INAUGURAL LECTURE, BY DR. WHEWELL. The reverend gentleman commenced by stating, that, having had no connection with the great event which they had met to discuss, further than being a mere spectator, he felt he was scarcely qualified to address them. The remarks which he had to make might, perhaps, be likened to the criticism which comes after the drama; for criticism comes after poetry, because words—the language of humanity—appear in the form in which the poet utters them, and works with them for his purposes, before they appear in the form in which the critic must use them: language is picturesque and affecting first; it is philosophical and critical afterwards: it is first concrete, then abstract: it acts first—it analyzes afterwards. And this is the case, not with words only, but with works also. The *Poet*, as the Greeks called him, was the *Maker*, as our English fathers also were wont to call him. And man's power of making may shew itself not only in the beautiful *texture* of language—the grand *machinery* of the epic, the sublime display of poetical *imagery*—but in those material works which supply the originals from which are taken the derivative terms just used; in the textures of soft wool, or fine linen, or glossy silk, where the fancy disports itself in wreaths of visible flowers; in the machinery, mighty as the thunderbolt to rend the oak, or light as the breath of air which carries the flower-dust to its appointed place; in the images which express to the eye beauty and dignity, as the poet's verse does to the mind;—so that it is difficult to say whether Homer or Phidias be more truly a poet. That mighty building, then, along the aisles

of which we have wandered, day after day, in past months, full as it was of the works of man, contained also the works of many who were truly makers—who stamped upon matter, and the combinations of matter, that significance and efficacy which makes it a true exponent of the inward activity of man. The objects there, the symbols, instruments, and manifestations of beauty and power, were utterances—articulate utterances of the human mind, no less than if they had been audible words and melodious sentences.

We must now consider what it is that we have admired, and why—must try to analyze the works which we have thus gazed upon, and to discover the principles of their excellence.

To discover the laws of operative power in literary works, though it claims no small respect under the name of criticism, is not commonly considered the work of a science; but to discover the laws of operative power in material productions, whether formed by man or brought into being by nature herself, is the work of a science, and is, indeed, what we more especially term science; and thus, in the case with which we have to do, we have, instead of the criticism which naturally comes after the general circulation of poetry, the science which naturally comes after a great exhibition of art—two cases of succession connected by a very close and profound analogy. That this view of the natural and general succession of science to art, as of criticism to poetry, is not merely fanciful and analogical, we may easily convince ourselves by looking, for an instant, at the progress of art and of science in past times; for we see that, in general, art has preceded science. Men have executed great, and curious, and beautiful works, before they had a scientific insight into the principles on which the success of their labours was founded. Art was the mother of science: the vigorous and comely mother of a daughter of far loftier and serener beauty. And as it had been in the period of scientific activity in the ancient world, so was it again in the modern period in which science began her later growth. The middle ages produced or improved a vast body of arts. The dawn of the sixteenth century presented, as it were, a Great Exhibition of the works which men had been producing from the time of the downfall of Roman civilization and skill. There might be seen by him, who travelled from land to land, beautiful textures, beautiful vessels of gold and bronze, of porcelain and glass, wonderful machines, mighty fabrics; and from that time, stimulated by the sight of such a mass of the works of human skill, men were led to seek for science as well as art—for science, as the natural complement of art, and fulfilment of the thoughts and hopes which art excites.

As the successful scientific speculations of the last three centuries have been the natural sequel to the art-energies of the preceding ages, so must the newest scientific speculations of our

contemporaries and their successors, in order to be successful, be the result and consequence of the powers, as yet often appearing in the undeveloped form of art alone, which exist among us at the present day; and thus, a great spectacle of the works of material art ought to carry with it its scientific moral. And the opportunities which we have lately had of surveying the whole of the world in which art reigns, and of appreciating the results of its sway, may well be deemed too valuable to be let slip for the purposes of that scientific speculation which is the proper sequence of such occasions. So it has seemed to those who have, from the beginning, taken a lofty, and comprehensive, and hopeful view of the great undertaking of which the first act is now completed; and especially to that mind which has always taken the most lofty, and comprehensive, and hopeful view.

It was said, that, in the sixteenth century, an intelligent spectator, by travelling from land to land, might have seen a wonderful collection of the works of man in many different countries; and, combining all these in his thoughts, he would have had in his mind a representation of the whole progress of human art and industry up to the last moment, and a picture of the place which each nation at that moment occupied in the line of that progress. But what time, what labor, what perseverance, what hardships, what access to great and powerful men in every land, what happiness of opportunity, would be implied in the completion of such a survey! A life would scarcely suffice for it; a man could scarcely be found who would achieve it, with all appliances and means which wealth and power could give. He must, like the philosophers of ancient days, spend all his years of vigour in travelling; must roam in the varied regions of India; watch the artisan in the streets of the towns of China; dive into the mines of Norway and of Mexico; live a life in the workshops of England, France, and Germany; and trace the western tide of industry and art as it spreads over the valley of the Mississippi. And when he had done all this, and however carefully he had done it, yet how defective must it be at least in one point! How far must it be from a *simultaneous* view of the condition of the whole globe as to material arts! During the time that he has been moving from place to place, the face of the world has been rapidly changing. Even if his picture were complete as to surface, what anachronisms must there be in it! How much that expresses not the general view of the earth, but the accidental peculiarities of the traveller's personal narrative! And then, how dim must be the images of the thing seen many years ago compared with that which is present to the eye! How impossible to compare the one with the other—the object now seen in age with a similar object remembered in youth! And after all, his knowledge is only his own. He cannot, in any clear or effective manner, communicate any large portion of it to others.

It exists only for him—it perishes with him! We have, however, had brought home to us the choicest productions of human art in all nations; or, at least, collections which might be considered as representing all nations. Now, in nations compared with nations, there is a difference;—in a nation, compared with itself at an earlier time, there is a progress. There may not always be a progress in good government;—there may not necessarily be, though we would gladly hope that there is, a progress in virtue, in morality, in happiness; but there always is—except when very adverse influences roll back the common course of things—a progress in art, and generally in science. In the useful and ornamental arts, nations are always going forwards, from stage to stage. Different nations have reached different stages of this progress; and all their different stages are seen at once, in the aspect which they have at this moment in the magical glass which the enchanters of our time have made to rise out of the ground like an exhalation. The infancy of nations, their youth, their middle age, and their maturity, all appear, in their simultaneous aspect, like the most distant objects revealed at the same moment by a flash of lightning in a dusky night: or we may compare the result to that which would be produced, if we could suppose some one of the skilful photographers, whose subtle apparatus we have had exhibited there, could bring within his field of view the surface of the globe, with all its workshops and markets, and produce, instantaneously, a permanent picture, in which the whole were seen side by side. But it is not a mere picture of things which are found standing together that we have had presented to us; the great achievement was the bringing them together. We have seen and examined examples of the food and clothing, and other works of art of nations in every stage of the progress of art. From Otaheite, so long, in the eyes of Englishmen, the type of gentle but uncultured life, Queen Pomare sends mats and cloth, head-dresses, and female gear, which the native art of her women fabricates from their indigenous plants. From Labuan, the last specimen of savage life with which this country has become connected, we have also clothes and armour, weapons and musical instruments. From all the wide domains which lie within or around our Indian empire, we have rich and varied contributions: from Sincapore and Ceylon, Celebes, and Java, Mengatal, and Palembang. The ruder and more primitive of these regions send us their native food and clothing, their fishing-nets and baskets; but art soon goes beyond these first essays. From Sumatra we have the loom and the plough, lacquered-work and silken wares; and as we proceed from these outside regions to that central and ancient India, so long the field of a peculiar form of civilization, we have endless and innumerable treasures of skill and ingenuity, of magnificence and beauty. And yet we perceive that, in advancing from these to the pro-

ductions of our own form of civilization, which has, even in that country, shewn its greater power, we advance also to a more skilful, powerful, comprehensive, and progressive form of art. And looking at the whole of this spectacle of the arts of life, in all their successive stages, there is one train of reflection which can hardly fail to strike us; namely, this:—In the first place, that man is, by nature, and universally, an artificer, an artisan, an artist. Even we, while we look down from our lofty summit of civilized and mechanically-aided skill upon the infancy of art, may often learn from savage life lessons of taste. So wonderfully and effectually has Providence planted in man the impulse which urges him on to his destination—his destination, which is, to mould the bounty of nature into such forms as utility demands, and to shew, at every step, that with mere utility he cannot be content. And when we come to the higher stages of cultured art—to the works of nations long civilized, though inferior to ourselves, it may be, in progressive civilization and mechanical power, how much do we find in their works which we must admire—which we might envy—which, indeed, might drive us to despair! Wherein, then, is our superiority? In what do we see the effect, the realization, of that more advanced stage of art which we conceive ourselves to have attained? What advantage do we derive from the immense accumulated resources of skill and capital—of mechanical ingenuity and mechanical power which we possess? Surely our imagined superiority is not all imaginary!—surely that mighty thought of a progress in the life of nations is not an empty dream!—and surely our progress has carried us beyond them! Where, then, is the import of the idea in this case? What is the broad and predominant distinction between the arts of nations, rich, but in a condition of nearly stationary civilization, like Oriental nations, and nations which have felt the full influence of progress, like ourselves?

The difference may, perhaps, be briefly expressed thus:—In those countries, the arts are mainly exercised to gratify the tastes of the few; with us to supply the wants of the many. There, the wealth of a province is absorbed in the dress of a mighty warrior; here, the gigantic weapons of the peaceful potentate are used to provide clothing for the world; for that which makes it suitable that machinery, constructed on a vast scale, and embodying enormous capital, should be used in manufacture, is, that the wares produced should be very great in quantity, so that the smallest advantage in the power of working, being multiplied a million fold, shall turn the scale of profit: and thus, such machinery is applied when wares are manufactured for a vast population; when millions upon millions have to be clothed, or fed, or ornamented, or pleased with the things so produced. This is the meaning of the vast and astonishing prevalence of machine-work in this country:—that the machine, with its million

fingers, works for millions of purchasers, while, in remote countries, where magnificence and savagery stand side by side, tens of thousands work for one. There, art labours for the rich alone; here, she works for the poor no less. There, the multitude produce only to give splendour and grace to the despot or the warrior whose slaves they are, and whom they enrich; here, the man who is powerful in the weapons of peace, capital, and machinery, uses them to give comfort and enjoyment to the public, whose servant he is, and thus becomes rich while he enriches others with his goods. If this be truly the relation between the condition of the arts of life in this country and in those others, may we not, with reason and with gratitude, say, that we have, indeed, reached a point beyond theirs in the social progress of nations?

The lecturer then reverted to the labor of classifying the subjects contained in the Exhibition, and gave his unqualified approbation of the arrangement that had been adopted. In following out this subject he was led to remark on the advantages that would be derived from a permanent and generally-accepted classification of all the materials, instruments, and productions of human art and industry. One consequence would be, that the manufacturer, the man of science, the artisan, the merchant, would have a settled, common language, in which they could speak of the objects about which they are concerned. It is needless to point out how much this would facilitate and promote their working together—how fatal to co-operation is diversity and ambiguity in the language used. One of our old verse writers, expanding, according to the suggestions of his fancy, the account of the failure of men in the case of the tower of Babel, has made this cause of failure very prominent. He supposes, that the language of the workmen being confounded, when one of them asked for a spade, his companion brought him a bucket; or when he called for mortar, handed him a plumb-line; and that, by the constant recurrence of these incongruous proceedings, the work necessarily came to a stand. Now, the conditions necessary, in order that workmen may work together, really go much farther than the use of a common language, in the general sense of the phrase. It is not only necessary that they should call a brick a brick, and a wire a wire, and a nail a nail, and a tube a tube, and a wheel a wheel; but it is desirable also that wires, and nails, and tubes, and wheels should each be classified and named; so that all bricks should be one size; so that a wire, number 3, or a tube, section 1, or a six-inch wheel, should have a fixed and definite signification; and that wires, and tubes, and wheels should be constructed so as to correspond to such significations; and even, except for special purposes, no others than such. It may easily be conceived, for instance, how immensely the construction, adjustment, and repair of wheel-

work would be facilitated if wheels of a certain kind were all made with teeth of the same kind, so that any one could work in any other. And something of this sort—something which secures some of these, and the like advantages, has been done with reference to cast-iron toothed wheels. An eminent engineer, who contributed largely to Class VI., has also proposed a system by which a like uniformity should be secured in the dimensions and fitting of machinery, and especially with regard to screws; fixing thus their exact diameter and pitch, as it is called—a process which would have the like effect of making the construction, application, and repair of all work into which screws enter, vastly more easy and expeditious than it now is. Now, these are the great and beneficial effects which follow from a good and generally-accepted sub-classification of one of the lowest members of that classification which the Catalogue exhibits to us. Mr. Whitworth would classify screws, and wheels, and axles, as the millwrights have classified toothed wheels; but screws, or wheels, or axles, are merely one kind of tool—one element of machinery; and tools and machinery are only one class out of thirty of the great collection of which we are speaking. If, then, so great benefits arise from a common understanding as to the species of one of the lowest members of our classification, may we not expect corresponding advantages from a fixation of the names and distinctions of the higher members?—of the names of tools and machines, for instance; and from a perception of their relations to each other, which a good classification brings into view; and then, again, from a clear perception of the relation of class to class, and of their lines of demarcation? And may we not expect, that, on such grounds, the very language of art and industry, and the mode of regarding the relations of their products, shall bear for ever the impress of the Great Exhibition of 1851?

He next proceeded to shew how different was the relative progress of art and science in the classes under which the contributions to the Exhibition had been divided. Thus, in the first class, *Mining and Mineral Products*, art existed before science, and has, even now, scarcely overtaken her; but in the second class, *Chemical Processes and Products*, science has not only overtaken art, but is the whole foundation, the entire creator of the art. With reference to *Animal and Mineral Substances*, the lecturer said:—Who knows what beautiful materials for the makers of furniture are to be found in the collections of woods from the various forests of the Indian Archipelago, or of Australia, or of Tasmania, or of New Zealand? Who knows what we may hereafter discover to have been collected of fruits, and oils, and medicines, and dyes; of threads and cordage, as we *had* here from New Zealand and from China examples of such novelties; of gums and vegetable substances, which may, in some unfore-

seen manner, promote and facilitate the processes of art? How recent is the application of caoutchouc to general purposes!—yet we know now—and on this occasion, America would have taught us if we had not known—that there is scarcely any use to which it may not be applied with advantage. If a teacher in our time were to construct maxims like those of the son of Sirach in the ancient Jewish times—like him who says (Ecclus. xxxix. 26): “The principal things for the whole use of man’s life are water, fire, iron, and salt, flour of wheat, honey, milk, and the blood of the grape, oil, and clothing”—he could hardly fail to make additions to the list, and these would be from the vegetable world. Again, how recent is the discovery of the uses of gutta-percha? In the great collection were some of the original specimens sent by Dr. Montgomery to the India House, whence specimens were distributed to various experimentalists. Yet how various and peculiar are now its uses, such as no other substance could replace! And is it not to be expected, that our contemporaries, joining the insight of science to the instinct of art, shall discover, among the various sources of vegetable wealth which the Great Exhibition has disclosed to them, substances as peculiar and precious, in the manner of their utility, as those aids thus recently obtained for the uses of life?

In concluding his lecture, the reverend gentleman said—May we not expect that, from this time, the eminent producers and manufacturers, artisans and artists, in every department of art, and in every land, will entertain for each other an increased share of regard and good will—of sympathy in the great objects which man’s office as producer and manufacturer, artisan and artist, places before him—of respect for each other’s characters, and for the common opinion of their body, all increased by their being able to say, “We were students together at the Great University in 1851.”

LECTURE I.

Dec. 2nd, 1851.

Mining, quarrying, and metallurgical processes and products.

By SIR HENRY T. DE LA BECHE, C.B., F.R.S.

The lecturer commenced by remarking that geographical position constitutes a most important element in the consideration of the mineral wealth of a country or district; for, other conditions being equal, it may decide on the propriety of their extraction or non-extraction. Even important minerals may be so situated as to be unproductive of advantage to those endeavouring to obtain them for use. It therefore becomes important that, when specimens of minerals are shewn as illustrative of mineral wealth,

especial reference should be made to those processes by which such matters are rendered useful. Without this precaution, much misconception may arise. Let us, for example, consider the ores of the metals. The mere exhibition of any ore, however rich, is, in itself, of little value, beyond the information that the specimen came from some stated locality. The circumstances connected with its mode of occurrence, and with the means at command to render its extraction useful, are essential. Pieces of rich ores are of frequent occurrence in localities where, from a want of their sufficient abundance, it would be useless to attempt any profitable working of them. Hence, collections of ores may often be most fallacious; indeed it is, unfortunately, somewhat too common to find specimens of ores shewn as the ordinary products of mines where they are really rarities, for the purpose of promoting the purchase of shares in such mines. There is a name for such specimens in Cornwall, where they are termed *stocking stones*. These really come from the mines; but they are unfair representations of their produce.

As fuel (said the lecturer) is at the base of all the operations, the products of which have found a place in the late Exhibition, it may, in the first instance, be desirable to glance at that portion of fuel which is included in Class I.

All our mineral, or, as it has been termed, fossil-fuel, is derived from vegetable matter,—the growth of various geological times, and of different regions, embedded amid detrital matter of various kinds from local circumstances, and presenting modified aspects in accordance with the general physical and chemical conditions to which it has been subjected. Its chief divisions, for industrial purposes, may be regarded as lignite (the *brown coal* of the Germans), and coal, the latter of various kinds. Indeed, the whole constitutes a series, at which woody matter, but slightly altered, is at one end, and stone-coal, or anthracite, is at the other. It may suffice for our present purpose to mention, that the physical and chemical conditions above mentioned are the causes of these differences, and have been of such an order that the proportion of the oxygen and hydrogen of the original vegetable substance became gradually diminished, as regards the other two component parts carbon and nitrogen; so that the carbon greatly predominates, and stone-coal, or anthracite, is the result.

Now, the character of these fossil-fuels is of the greatest importance in their varied uses,—the products of many operations depending upon it, especially certain metallurgical processes. As this character does not necessarily depend upon geological age—though, as a whole, the older rocks usually contain only that state of fossil-fuel known as coal of some kind—it may be expected to vary materially in different parts of the world. The kind of fossil-fuel found, may determine the development of certain branches of industry, other circumstances being favorable.

As regards the coals of the world, it is well known that, though our country may not be that containing the largest amount of fossil-fuel (the United States far exceeding us in this respect), it is, at the present moment, nevertheless, the land in which the largest amount is raised. The annual weight raised in this country is usually now estimated as equal to 35,000,000 of tons; or, taking the ton of coal as equal to about a cubic yard, more than eleven square miles of a bed of coal three feet thick, supposing the whole of the coal removed. Of this large amount, about 2,728,000 tons are exported, leaving the remainder, or 32,272,000 tons for domestic and industrial consumption,—the portion devoted to the latter being largely employed for the smelting of our ores, especially those of iron.

As illustrative of the importance of our position as a maritime state, combined with our possession of cheap heat, well situated, the copper smelting of Swansea, with that of Neath, Tai-bach, and Llanelly in its vicinity, was adduced. To these places, in addition to the greater portion of the copper raised in the British Islands, cargoes of that ore, and of what is termed the regulus of copper, are brought round by the Cape of Good Hope from Australia in one direction, and round Cape Horn from Chili and other South American lands, in another.

Though regarding the specimens of coal, as such, and unconnected with processes to which they were material, the Exhibition might be defective, it contained important illustrations of the mode of occurrence and of extraction of coal. Among the maps, sections, and collections, connected with this subject, the exhibition from the coal district of Northumberland and Durham should be cited. It formed an important series of illustrations, comprising maps, sections, specimens of the various coals, the rocks by which they are accompanied, plans of the mode of working the collieries, sections of pits, and the machinery in them, with the safety-lamps used in the district—a highly valuable series, and one formed expressly for the Exhibition. A beautiful model by Mr. Nicholas Wood exhibited the methods of working coal in the northern counties. There were others also in the English department alike instructive, as directing attention to that important subject, the ventilation of collieries, one which has so justly of late attracted public attention.

As relating to the ventilation of collieries, a model of opening and closing the doors in them, by the passage of the horses and waggons, or of the men, without the attendance of boys or others for the purpose, had very important bearings, so many accidents having occurred from the ventilation being disarranged by leaving open such doors. It was a good case of a valuable contrivance, apparently little known beyond the colliery itself—the Foxhole Colliery, near Swansea—being made more extensively so by means of the Exhibition.

As connected in the Exhibition with collieries, though in reality applicable to shafts generally in mines, the lecturer noticed the method adopted by Mr. E. Rogers, of sinking shafts at Abercarn Colliery, Monmouthshire. By employing electricity in blasting, he is enabled to explode three or more holes, inclined to each other in the depth, simultaneously; and thus lifts a large mass at once from the centre of the sinking,—other large masses being in like manner afterwards detached from the surrounding portions towards the sides.

In the French department, and in a small case, accompanied by a description and explanatory drawing, the whole seldom heeded amidst more showy objects, were to be seen some sorted and crushed coals, with a few pieces of coke, having an important bearing upon the employment of cheap and effective heat. It illustrated the method of M. Bérard, for separating foreign matter, such as iron pyrites and slate, from coal. Its general principle was that of the "jigging-machine" of the miners, for separating ores, after crushing, from the stony matter with which they may be associated, by agitating the whole in water, so that the various portions become arranged according to their specific gravities. By using the method of M. Bérard, the Chemin de Fer du Nord, France, was enabled to employ a coal previously found injurious to the locomotives, and a considerable saving was effected.

The subject of metal mining was said to include a consideration of the ores, as such; their mode of occurrence in the ground; the methods employed for their extraction; and the means adopted for "dressing" them, as it is termed, or of rendering them marketable. The smelter then receives them, and by such metallurgical processes as may be suitable produces the metal.

Respecting the mode of occurrence of ores—a most important point—the Exhibition did not furnish many illustrations. As regards specimens of that character, it was not to be expected that they could be readily sent. Such collections are the work of time; requiring, moreover, a constant attention to given objects of inquiry, in connection with the general subject, as is abundantly proved by the difficulty experienced by all mining schools in satisfying these requirements. A fine illustrative collection of this kind is contained in the Museum in Jermyn Street, but it took sixteen years, and that with the hearty co-operation of able men in the mining districts, to obtain it.

The mode of occurrence of the metalliferous ores is twofold, viz., in beds or layers, or filling cracks, fissures, and other cavities. The clay ironstones, and certain oxides, known as bog-iron ore, belong to the former division. The alluvial, or other detrital beds, in which gold is found, as in California, Australia, Russia, and many other lands, may be considered as also included in it. In Merthyr Tydvil, the chief locality for iron works in

South Wales, some beds of ironstone often present constant characters for considerable distances, while others are more variable in composition and thickness.

Looking at the auriferous beds in some regions, even those from which much gold may, as a whole, be obtained, we must often regard the mode of occurrence of the metal as, taken with the bed, to represent a poor ore. When, as in some of the Russian gold washings, two hundred tons of the detrital mass has to be washed and examined, to obtain a single pound weight of gold, it can be viewed as little else.

The best illustration presented by the Exhibition of the mode of occurrence of the clay ironstones and associated coal, was that afforded by the beautiful model accompanying the Ebbw Vale collections; the sequence in which, from the coals, ironstones, and limestone used, through the models of the furnaces to the various products, was highly instructive, and creditable to the Company exhibiting them. The model was formed of an original part made by Mr. Thomas Sopwith (so well known for his skill in that department as well as in others), to which the Company had added a continuation. The model is constructed to a common scale for height and distance,—the surface represented to correspond with the actual ground, with the rivers, roads, fields, and buildings, while the lower part exhibits—every coal and ironstone bed being shewn—the true relative positions of the various beds with the works which have been carried on upon them. Considering how completely these models may be made to record all the workings, and how far superior they are to the usual plans and sections, it is surprising that they should not be more used than they are, affording, as they do, such clear and accurate information to all interested.

As to illustrations of the mode of occurrence of ores in mineral veins or lodes, the most instructive and important were specimens of part of the silver lode of Kongsberg, Norway; and of part of the lead lode of Grassington, Yorkshire, sent by the Duke of Devonshire.

The means of extracting ores from the metalliferous mines were but slightly represented. There were illustrations of safety fuses, for blasting, some methods of raising and lowering the miners and for raising the ores, and a few Cornish mining sections. With reference to this subject, however, a large and beautiful model of water-wheels, connected with pumps, from the Devon Great Consols Copper-mines, requires especial mention. The dressing of ores did not receive much illustration.

With respect to the metallurgical processes and the metals produced, the case was different, more especially as regards iron. This metal, the most important to mankind, formed the chief feature in Class I., whether in the British or Foreign departments. There were some excellent illustrations from different

British iron-works, including the ores and fuel employed. Canada and Nova Scotia exhibited their iron: some bar-iron, of good quality, from the former, was remarkable for being manufactured from bog-iron ore, not usually found good for bar-iron.

The Austrian series of iron was excellently well displayed, and very illustrative. Many parts of the series shewed the ores whence the metal had been obtained, with the various parts of the processes, including the slags. In this collection was a most remarkable example of the fine rolling of iron,—the latter itself being necessarily of excellent quality. The “iron paper,” as it was termed, from Neudeck, in Bohemia, was superior to all of its kind exhibited; and was cited by the lecturer to illustrate the utility of the Great Exhibition. It soon attracted the attention of those skilled in iron, as such thin rolled iron is important for button-making. A spirited party, connected with the iron trade, at once proposed, in a proper quarter, to imitate this Bohemian product. This was attempted, and though the result was not quite equal to the original, before the Great Exhibition closed, thin rolled iron, of a quality not heretofore produced in this country, was to be had in the market.

There were good illustrations also of the Belgian iron, as employed for various purposes; and other countries, known as rich in that metal, forwarded some good specimens.

The Exhibition may be said to have given rise to the most complete view of the iron produce of this country which we possess. Mr. Samuel Blackwell, himself an ironmaster, accompanied the collection of iron ores, previously mentioned, by a statement of great value. He estimates the gross annual production of iron in Great Britain to be now upwards of 2,500,000 tons. “Of this quantity, South Wales furnishes 700,000 tons; South Staffordshire (including Worcestershire), 600,000 tons; and Scotland, 600,000 tons. The remainder is divided among the various smaller districts.” The iron of England and Wales was produced by 336 furnaces in blast in 1850. Though a considerable quantity of British iron is exported, a very large proportion remains to be variously employed in our own industry.

With regard to copper, the chief illustration of its smelting, as practised in this country, came, as might be expected, from Swansea, where, as has been already stated, so much of the copper ore, not only of the British Islands, but of other parts of the world, is converted into metal. The series sent was important. The Messrs. Bankart exhibited illustrations of their patent process of reducing copper ores. Though referred to Class 2, mention should be here made of Mr. Longmaid’s process of reducing copper ores. In it the sulphuret of iron and copper, known as copper pyrites, is roasted with chloride of sodium (common salt). Sulphate of soda is produced, the copper is converted into a soluble sulphate, the iron left, and the chlorine liberated. The

copper is then thrown down from its solution. There was also copper from the smelting works, Bruce mines, Lake Huron, Canada, and from the Burra-Burra copper mines. In the Zollverein department were to be found illustrations of the processes followed in extracting the copper from the cupriferous state of Mansfeld, and those also shewing the manner of obtaining the silver from the same beds: other foreign departments also furnished specimens.

The illustrations of lead were chiefly British; among which was an excellent exhibition of Pattinson's important process for desilverising that metal—a process which has been of great service to lead-mining generally,—rendering many lead-mines workable, with profit, which must otherwise have been abandoned. The lead-smelting at the Allenheads mines, and at the Wanlock Lead Hills, Dumfriesshire, both excellently displayed, are both founded on Pattinson's process. While touching on the Wanlock Lead Hills exhibition, the lecturer noticed the arrangements by which the fumes from the furnace are prevented from escaping, and from damaging the surrounding country, while lead, to the amount of thirty-three per cent. from the deposits, or "fume," is obtained. Other British, and also some foreign works, also transmitted illustrations of lead-smelting, in some cases accompanied by sheet-lead, lead pipes, lead wires and tape, or spun lead, as it was termed.

With regard to zinc, the chief exhibition was that of the *Vieille Montagne*, Belgium, dispersed in the Belgian, French, and English departments. This establishment is the most considerable of its kind in the world. The illustrations of its produce, sent by the Company to whom it belongs, were alike remarkable for their abundance, variety, and importance. The establishment now employs 2646 persons, and it produced 11,500 tons of zinc in 1850. With the exception of some ingots of zinc from the Eshweiler foundries, Stolberg (Zollverein department), and others from the Sterling Hill Mine, New Jersey, there would appear to have been no other illustrations of zinc-smelting and drawing.

As respects tin, Mr. Oxland's very important process for separating wolfram (tungstate of iron) from tin ore, was sent by the inventor from the Drake Walls Tin Mine, on the Cornish side of the Tamar.

The tin of Cornwall and Devon has long supplied the chief portion of that consumed in Europe and on the shores of the Mediterranean. In 1850, 10,025 tons of the ore were raised. Taking the ore at £50 per ton, it would have a value of £500,000 in that state in 1850. Tin is now imported from other lands. In 1850, 1798 tons of tin, chiefly from Banca, were imported; and 2211 tons were exported; shewing that only 413 tons of British tin found its way elsewhere,—the chief

part of our tin produce being reserved for our own industry, for which it is in many ways so important. Tin was shewn from the Malay peninsula; from Schlaggenwald, Bohemia, and from the Avion mountains, Spain.

Respecting silver, Pattinson's important process has been already mentioned. Attached to its illustrations was a large mass of silver, weighing 3000 ounces, well shewing the "spitting," as it has been termed, which takes place while the mass was cooling. In the Allenheads series there was a cake of silver, prepared by the same method, weighing 8000 ounces. The Kongsberg collection was completed by proper illustration of the silver itself. There was also smelted silver from Prince's Location, Lake Superior, Canada; from the Almeria mines, Spain; and from Eschweiler mines, Stolberg (Zollverein).

The most important exhibition connected with gold was that from Reichenstein, in Silesia. It afforded an excellent example of an application of science by which ores previously profitless became valuable. The process adopted was that of Professor Plattner, of Freiberg. The ores of the Reichenstein mines are arsenical pyrites, containing about 200 grains of gold in the ton. These are roasted in a reverberatory furnace, surmounted by a large condensing chamber, on which the arsenic is deposited, as it rises in fumes. Oxide of iron, a certain quantity of arsenic, and the gold in the ore, remain beneath. These are placed in a vessel, so that a current of chlorine gas is transmitted through them. The gold and iron are attacked, are separated from the residue by solution in water, and the gold is precipitated by sulphuretted hydrogen. The importance of the process is evident; and it is but just to Dr. Percy to state, that at the meeting of the British Association at Swansea, in 1848, he advocated the employment of chlorine for a similar purpose.

With respect to the metals platinum, palladium, iridium, and rhodium, they were shewn in their different metallurgic states by Messrs. Johnson and Matthey; and the method of reducing antimony was well illustrated by Mr. Hallett.

The class under consideration also included steels and the alloys generally of the metals considered as raw materials. As a steel exhibition alone, the most illustrative collection was that sent by Messrs. Naylor, Vickers, and Co. It was accompanied by a large and beautiful model of the furnaces, rolling-mills, and forge, and was, altogether, a most effective display of British steel. In the Zollverein department there was an excellent exhibition of steel by M. Krupp, of Essen, Dusseldorf. A broken cylinder of this steel, measuring fifteen inches in diameter, was particularly remarkable. There were illustrations of steels from various lands, and they, with the irons, may be regarded as the most effective part of the metallic collections in the Exhibition.

Brass and other alloys were well illustrated; but they were usually so combined in manufactures as not to come under Class I.

In speaking of plumbago, the lecturer referred to the compressing process patented by Mr. Brockedon, of which illustrations were in the Exhibition. By this process, much of the Borrowdale plumbago dust has been utilized with advantage. The plumbago is ground into fine powder, placed in packets, and then receives a pressure equal to about 5,000 tons. To prevent the injurious effect of disseminated air in the packets of fine powder, it is extracted by means of an air-pump; and thus the particles themselves can be brought into close juxtaposition and forced to cohere. Of the application of plumbago to crucibles, there were several examples,—some well known for their quality.

The lecturer also shortly noticed the collections of building stones, marbles, slates, clays, mineral manures, and gems, contributed to the Great Exhibition; and concluded his address with the following remark:—Science is essential to progress in our department; and it is most cheering to find its union with practice daily becoming more thoroughly appreciated in this country, where hitherto we have not enjoyed the educational advantages, as regards instruction connected with industry, possessed by many other nations. We have had the advantage of seeing, during the late Exhibition, how eagerly our foreign brethren in industry seized upon all shewing the useful applications of science; how anxious they were to visit the localities whence illustrations of them were derived. Let us not be laggards in the same field. Let us strive to learn as well as teach; and thus improve, for the advantage of all, the good fellowship established, by the influence of the Great Exhibition, among so many able men of various lands.

Scientific Adjudication.

COURT OF QUEEN'S BENCH, WESTMINSTER.

(Sittings at Nisi Prius, before Lord Campbell and a Special Jury.)

5th Dec., 1851.

REGINA V. STEINER.

The Attorney-General, Mr. Cleasby, and Mr. Hindmarch, appeared for the Crown; and Sir F. Thesiger, Mr. Watson, Q.C., Mr. Cowling, and Mr. Webster, for the defendant.

This case, which lasted for three days, was a proceeding, by *scire facias*, to repeal a patent, granted on the 8th of August, 1843, to Frederick Steiner, for "a new manufacture of a certain coloring matter, commonly called garancine," being a communi-

cation from abroad. The coloring matter termed garancine is extracted from the root of the madder plant, and is extensively used in dyeing various kinds of manufactures. For a long time, the coloring matter was extracted by the means of hot water, the refuse, termed "spent madder," being considered useless. It was believed, however, that the spent madder contained a considerable quantity of coloring matter in combination with the woody fibre of the root, and various plans were, from time to time, suggested for extracting this matter, and turning it to a useful purpose. The defendant, Steiner, a native of Alsace, a place celebrated for the culture of the madder plant, obtained a patent for this object on the 2nd June, 1832. According to the specification of that patent, diluted sulphuric acid, of the strength of 1.020, was to be employed. That method was, by the specification, stated to be applicable to the extraction of the coloring matter from both fresh and "spent madder;" but it did not appear that so weak a solution of sulphuric acid had much effect in extracting the coloring matter from "spent madder." The defendant, subsequently, in August, 1843, took out the patent now in question, which was specially applicable to the extraction of coloring matter from "spent madder." According to the specification of this patent, a much stronger solution of sulphuric acid was employed; and the operation of this solution being further assisted by the addition of artificial heat, it was found that a large portion of coloring matter, held in combination with the fibre of the wood, could be obtained. It appeared that Messrs. Heald & Wilson, of Manchester, had, for some time, held a license from the defendant for the use of his invention; but, conceiving that the invention was substantially included in the defendant's patent of 1832, they refused to continue to work under such license after the expiration of that patent in 1846.

On behalf of the Crown, it was contended that the patents of 1832 and 1843 were substantially the same; for, by using a stronger solution of sulphuric acid than was indicated by the specification of the first patent, the heat, which was considered as constituting the improvement in the second patent, was obtained—the combination of sulphuric acid, in a large proportion with water, producing a high degree of heat. Upon this ground, it was contended, that the defendant, in claiming the application of heat as a novelty, had claimed what was not new. Another objection taken to the defendant's patent of 1843 was, that the method there described was identical with that of the French chemists, Gaultier and Person, as explained in a work published in the French language in the year 1834, entitled *Manuel du Fabricans d'Indiennes*. This work was published nine years before the defendant's patent was taken out, and was proved to have been sold to many parties in England, and particularly at Manchester, in the year 1834, and following years. It was also

proved, by a Mr. Peake, a manufacturing chemist, that, before the year 1843, he had actually manufactured a ton of garancine from "spent madder," according to the instructions contained in the *Manuel*.

In support of the patent, several scientific witnesses of eminence were called, who gave their opinion that garancine could not be made in the mode pointed out by the *Manuel*; but, on cross-examination, it was ascertained that those witnesses, who spoke so positively upon this point, had never made the attempt, though some of them had been experimenting upon madder for several months. It also appeared, from the evidence given by defendant's witnesses, that the work in question was but little understood or appreciated by the parties most interested in its contents.

Lord Campbell, in summing up the evidence to the jury, said, the question for their determination was, whether the invention, at the date of the patent in 1843, was a novelty in this country. The defendant did not profess to be himself the inventor of the improvement, but to have received information of the discovery from a foreigner. If, however, he took out a patent for the invention before it had become known and practised in England, the patent was good in law; though, if it had become already known and practised, the patent should be repealed as void. The first question the jury would have to determine would be, whether the improvement claimed by the patent of 1843 was substantially claimed by that of 1832; but as they would probably be of opinion that it was not, the main question would be, whether the mode of applying sulphuric acid along with steam, as recommended by Gaultier and Person, was not perfectly well known in England by the publication of the *Manuel* for several years before the defendant took out his patent. His Lordship here called the attention of the jury to the evidence upon this point, and observed, how satisfactory it would have been if those scientific witnesses, who had spoken to the impossibility of making garancine in the mode pointed out in the *Manuel*, had made the attempt. If the attempt had been made, it would have been very satisfactory to the jury to have been informed of the result of the experiment; but, as that experiment had not been made, it naturally led to the inference, that they had abstained from making the experiment because they thought it would have answered too well. The jury would, however, judge between the parties, and say, whether, upon the whole, they thought the defendant's intention was substantially the same as that described in the *Manuel*, and whether they believed that the latter had become known and practised in this country before the year 1843.

The jury retired to consider their verdict, and upon their return into court, gave it in favor of the Crown.

List of Patents

That have passed the Great Seal of IRELAND, from the 17th November to the 17th December, 1851, inclusive.

-
- To Henry Richardson, of Aber Hourant Bala, North Wales, Esq., for certain improvements in life-boats.—Sealed 20th November.
- Thomas Crook, of Preston, in the county of Lancaster, cotton manufacturer, and James Mason, of Preston, aforesaid, warper, for certain improvements in looms for weaving.—Sealed 20th November.
- George Tate, of Bawtry, in the county of York, Gent., for improvements in the construction of dwelling houses and other buildings, including carriages and floating vessels; and in the propulsion of such vessels; and in the adaptation and manufacture of materials for such uses.—Sealed 2nd December.
- Philip Nind, of Leicester-square, Gent., for improvements in the manufacture of sugar, in distilling, and in cutting and rasping vegetable substances,—being a foreign communication.—Sealed 2nd December.
-

List of Patents

Granted for SCOTLAND, subsequent to 22nd November, 1851.

-
- To Richard Whytock, of Edinburgh, for improvements in applying colors to yarns or threads, and in weaving or producing fabrics where colored or party-colored yarns or threads are employed.—Sealed 24th November.
- Thomas Crook, of Preston, cotton manufacturer, and James Mason, of the same place, for certain improvements in looms for weaving.—Sealed 26th November.
- Thomas Cussons, of Bunhill-row, London, for improvements in ornamenting woven fabrics for bookbinding and other uses.—Sealed 26th November.
- Henry Ellwood, of the Firm of Ellwood and Sons, Great Charlotte-street, Blackfriars-road, London, wholesale hat manufacturer, for improvements in the manufacture of hats and other coverings for the head.—Sealed 26th November.
- John Ashworth, of Bristol, manager of the Great Western Cotton Works, for certain improvements in the method of preventing and removing incrustation in steam-boilers and steam-generators.—Sealed 26th November.
- Jonathan Grindrod, of Birkenhead, consulting engineer, for an improvement in the machinery for communicating motion from

steam-engines or other motive power; and in the construction of rudders for vessels.—Sealed 1st December.

William Bridges Adams, of No. 1, Adam-street, Adelphi, London, engineer, for certain improvements in the construction of roads and ways for the transit of passengers, of materials, and of goods; also in building, and in bridges, and in locomotive engines and carriages,—parts of which improvements are applicable to other like purposes.—Sealed 4th December.

Godfrey Ermen, of Manchester, cotton-spinner, for certain improvements in the method of, and apparatus for, finishing yarns or threads.—Sealed 8th December.

James Nasmyth, of Patricroft, in the county of Lancaster, engineer, and Herbert Minton, of Stoke-upon-Trent, in the county of Stafford, china manufacturer, for certain improvements in machinery or apparatus to be employed in the manufacture of tiles, bricks, and other articles, from disintegrated or pulverized clay.—Sealed 11th December.

Frederick William Norton, of Paisley, manufacturer, for certain improvements in the manufacture or production of plain and figured fabrics.—Sealed 12th December.

John Livesey, of New Lenton, Nottingham, draughtsman, for improvements in the manufacture of textile fabrics, and in machinery for producing the same.—Sealed 15th December.

John Cumming, of Paisley, pattern designer, for improvements in the production of surfaces for printing or ornamenting fabrics.—Sealed 15th December.

Herman Schroder, of Bristol, for improvements in manufacturing and refining sugar,—which improvements are applicable to evaporating other fluids, where a low temperature is advantageous.—Sealed 22nd December.

George Gwynne, of Hyde-park-square, London, and George Fergusson Wilson, managing director of Price's Patent Candle Company, of Belmont, Vauxhall, London, for improvements in treating fatty and oily matters, and in the manufacture of lamps, candles, night-lights, and soap.—Sealed 22d December.

New Patents

SEALED IN ENGLAND.

1851.

To William Exall, of Reading, in the county of Berks, engineer, for improvements in certain agricultural implements, and in steam-engines and boilers for driving the same. Sealed 1st December—6 months for enrolment.

George Laycock, late of Doncaster, in the county of York, but

- now of Albany, in the State of New York, in the United States of America, dyer, for improvements in unhairing and tanning skins. Sealed 1st December—6 months for enrolment.
- William Grayson, of Henley-on-Thames, in the county of Oxford, watch and clock-maker, for an odometer or road measurer, to be attached to carriages, for shewing distances over which the wheels pass. Sealed 1st December—6 months for enrolment.
- Thomas Burstall, of Lee-crescent, Edgbaston, in the county of Warwick, civil engineer, for certain improved machinery for manufacturing bricks and other articles from clay alone, or mixed with other materials. Sealed 1st December—6 months for enrolment.
- John Macintosh, of Berners-street, in the county of Middlesex, civil engineer, for improvements in steam-engines, in rigging and propelling vessels, and facilitating their progress through the water. Sealed 4th December—6 months for enrolment.
- William Wood, of Oxford-street, in the county of Middlesex, carpet manufacturer, for improvements in the manufacture and ornamenting of carpets, rugs, and other fabrics. Sealed 4th December—6 months for enrolment.
- James Thompson and Frederick Altree, of Compton-street, Brunswick-square, bakers, for certain improvements in the means of, and apparatus for, heating ovens. Sealed 5th December—6 months for enrolment.
- Joseph Harrison, of 10, Oxford-square, Hyde-park-gardens, engineer, for certain improvements in steam-engines. Sealed 8th December—6 months for enrolment.
- Peter Armand Le Comte de Fontainemoreau, of South-street, Finsbury, for improvements in the apparatus for kneading and baking bread and other articles of food of a similar nature,—being a communication. Sealed 8th December—6 months for enrolment.
- Richard Archibald Brooman, of the firm of J. C. Robertson & Co., of Fleet-street, London, for certain improved modes of applying electro-chemical action to manufacturing purposes,—being a communication. Sealed 8th December—6 months for enrolment.
- Richard Archibald Brooman, of Fleet-street, London, for improvements in the manufacture of sugar, in the preparation of certain substances for such manufacture, and in the machinery and apparatus employed therein,—being a communication. Sealed 8th December—6 months for enrolment.
- Isaac Alexander, of 112A, High Holborn, biscuit baker, for a mode of preparing and treating certain kinds of cheese, whereby to render the same applicable to a variety of culinary and other domestic purposes. Sealed 8th December—6 months for enrolment.
- Perry G. Gardiner, of New York, civil engineer and machinist,

for improvements in the manufacture of malleable metals into pipes, hollow shafts, railway wheels, or other analogous forms, which are capable of being dressed, turned down, or polished in a lathe. Sealed 8th December—6 months for inrolment.

Charles Cowper, of Southampton-buildings, Chancery-lane, for improvements in separating coal from foreign matters, and in apparatus for that purpose,—being a communication. Sealed 8th December—6 months for inrolment.

William Pidding, of the Strand, in the county of Middlesex, Gent., for improvements in the treatment, manufacture, and application of materials or substances for building purposes. Sealed 8th December—6 months for inrolment.

John Lake, of Apsley, in the county of Hertford, civil engineer, for improvements in propelling on canals and rivers. Sealed 8th December—6 months for inrolment.

Thomas Restell, of the Strand, in the county of Middlesex, watch-maker, for improvements in locks or fastenings. Sealed 8th December—6 months for inrolment.

John Frearson, of Birmingham, for improvements in cutting, shaping, and pressing metal and other materials. Sealed 10th December—6 months for inrolment.

James Webster, of Leicester, for improvements in drying gloves and other articles of hosiery. Sealed 10th December—6 months for inrolment.

Etienne Alexander Armand, of Paris, for improvements in the modes of distilling and treating organic substances and bituminous matters, and in the treatment of their products, together with the apparatus used for the said purposes. Sealed 10th December—6 months for inrolment.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in dyeing textile fabrics,—being a communication. Sealed 10th December—6 months for inrolment.

Thomas Masters, of Regent-street, confectioner, for improvements in retaining and drawing off aerated and other liquids, and in charging vessels with gaseous fluids, applicable to vessels for holding solid matters; and also as a fastening for utensils, and apparatus, and in holders for cigars. Sealed 11th December—6 months for inrolment.

Thomas Twells, of Nottingham, manufacturer, for certain improvements in the manufacture of looped fabrics. Sealed 15th December—6 months for inrolment.

Frederick William Norton, of Paisley, in the county of Renfrew, North Britain, manufacturer, for certain improvements in the manufacture or production of plain and figured fabrics. Sealed 16th December—6 months for inrolment.

John Gedge, of Wellington-street, Strand, in the county of Middlesex, for improvements in the treatment of certain substances

- for the production of manures,—being a communication. Sealed 17th December—6 months for enrolment.
- James Souter and James Worton, of Birmingham, for improvements in the manufacture of papier-maché, and in articles made therefrom; and in the manufacture of buttons, studs, and other articles where metal and glass are combined. Sealed 17th December—6 months for enrolment.
- William Hirst, of Manchester, manufacturer, for certain improvements in machinery or apparatus for manufacturing woollen cloth, and cloth made from wool and other materials. Sealed 19th December—6 months for enrolment.
- Moses Poole, of the Patent Bill Office, London, Gent., for improvements in apparatus for excluding dust and other matters from railway-carriages, and for ventilating them,—being a communication. Sealed 19th December—6 months for enrolment.
- Henry Clayton, of Atlas Works, Upper Park-place, Dorset-square, for improvements in the manufacture of tubes, pipes, tiles, and other articles made from plastic materials. Sealed 19th December—6 months for enrolment.
- Samuel Wilkes, of Wolverhampton, brass-founder, for improvements in the manufacture of kettles, saucepans, and other cooking vessels. Sealed 19th December—6 months for enrolment.
- Joseph Burch, of Craig Works, Macclesfield, for improvements in printing and ornamenting cut pile and other fabrics and yarns. Sealed 19th December—6 months for enrolment.
- Christopher Rands, of Shad Thames, miller, for improvements in grinding wheat and other grain. Sealed 19th December—6 months for enrolment.
- James Frederick Lackersteen, of Kensington-square, civil engineer, for improvements in machinery for cutting or splitting wood and other substances, and in the manufacture of boxes. Sealed 19th December—6 months for enrolment.
- Frederick Bousfield, of Devonshire-place, Islington, Gent., for a new manufacture of manure. Sealed 19th December—6 months for enrolment.
- Charles Howland, of New York, engineer, for improvements in apparatus for ascertaining and indicating the supply of water in steam-boilers. Sealed 19th December—6 months for enrolment.
- William Elliott, of Birmingham, manufacturer, for improvements in the manufacture of covered buttons. Sealed 19th December—6 months for enrolment.
- Rodolphe Helbronner, of Regent-street, for improvements in apparatus used when obtaining instantaneous light. Sealed 19th December—6 months for enrolment.
- John Thornton and James Thornton, both of Melbourne, in the county of Derby, mechanics, for improvements in the manu-

facture of meshed and looped fabrics and other weavings; and in raising pile on looped fabrics and other weavings. Sealed 19th December—6 months for inrolment.

William Emery Milligan, mechanical engineer, of the City of New York, for certain improvements in the construction of boilers for generating steam. Sealed 19th December—6 months for inrolment.

Charles Lamport, of Workington, in the county of Cumberland, ship-builder, for improvements in reefing sails. Sealed 19th December—6 months for inrolment.

Richard Archibald Brooman, of Fleet-street, for improvements in sounding instruments,—being a communication. Sealed 19th December—6 months for inrolment.

John Davie Morries Stirling, of Black Grange, North Britain, Esq., for certain alloys and combinations of metals. Sealed 22nd December—6 months for inrolment.

Sydney Smith, of Nottingham, for improvements in indicating the height of water in steam-boilers. Sealed 22nd December—6 months for inrolment.

Augustus Applegath, of Dartford, in the county of Kent, for improvements in machinery used for printing. Sealed 24th December—6 months for inrolment.

Antonio de Sola, of Madrid, in the Kingdom of Spain, for certain improvements in the treatment of copper minerals,—being a communication. Sealed 24th December—6 months for inrolment.

Christopher Nickels, of York-road, Lambeth, and Thomas Ball, and John Woodhouse Bagley, of Nottingham, for improvements in the manufacture of knitted, looped, and other elastic fabrics. Sealed 24th December—6 months for inrolment.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in separating substances of different specific gravities,—being a communication. Sealed 24th December—6 months for inrolment.

Joseph Stenson, of Northampton, engineer and iron manufacturer, for improvements in the manufacture of iron, and in the steam apparatus used therein,—part or parts of which are also applicable to evaporative and motive purposes generally. Sealed 27th December—6 months for inrolment.

CELESTIAL PHENOMENA FOR JANUARY, 1862.

D. H. M.		D. H. M.	
1	Clock before the ☉ 3m. 37s.	17	Juno, R. A., 19h. 52m. dec. 13. 1. S.
—	☿ rises 0h. 50m. A.	—	Pallas, R. A., 3h. 5m. dec. 24.
—	☿ pass mer. 7h. 37m. A.	—	36. S.
—	☿ sets 1h. 29m. M.	—	Ceres, R. A., 6h. 24m. dec. 29.
2 25	☿ in Perihelion.	—	44. N.
16 25	☿ in conj. with Juno, diff. of dec.	—	Jupiter, R. A., 15h. 8m. dec. 16.
	6. 35. S.	—	52. S.
2 1 51	☉ in Perigee	—	Saturn, R. A., 1h. 46m. dec. 8.
3	Occul. ☿ ¹ Tauri, im. 16h. 50m.	—	22. N.
	em. 17h. 20m.	—	Uranus, R. A., 1h. 54m. dec. 11.
4 5 58	♃'s first sat. will im.	—	11. N.
5	Clock before the ☉ 5m. 28s.	—	Mercury pass mer. 22h. 40m.
—	☿ rises 2h. 42m. A.	—	Venus pass mer. 1h. 59m.
—	☿ pass mer. 10h. 54m. A.	—	Mars pass mer. 12h. 54m.
—	☿ sets 6h. 6m. M.	—	Jupiter pass mer. 19h. 21m.
23 23	☿ in inf. conj. with the ☉	—	Saturn pass mer. 6h. 1m.
7	Moon total eclipse.	—	Uranus pass mer. 6h. 8m.
4 20	Begins } Magnitude of the	18 3 30	♃ in ☐ with the ☉
6 10	Middle } Eclipse	18 49	Juno in conj. with the ☉
7 59	Ends } 1.667 (☿ dia.=1.)	23 4	☿ in conj. with the ☿ diff. of dec.
6 9	Ecliptic oppo. or ☉ full moon		1. 41. N.
15 38	☿ greatest hel. lat. S.	19 4 30	♃'s third sat. will im.
8 11 41	♂ in conj. with the ☿ diff. of	19 5 8	♃'s second sat. will im.
	dec. 2. 8. N.	6 31	♃'s third sat. will em.
22 48	♃ stationary	20	☉ eclipsed, invis. at Greenwich
9	Occul. 37 Leonis, im. 18h. 44m.	—	Clock before the ☉ 11m. 12s.
	em. 19h. 38m.	—	☿ rises 7h. 29m. M.
10	Clock before the ☉ 7m. 37s.	—	☿ pass mer. 11h. 30m. M.
—	☿ rises 8h. 22m. A.	—	☿ sets 3h. 30m. A.
—	☿ pass mer. 2h. 45m. M.	4 13	♃'s first sat. will im.
—	☿ sets 10h. 15m. M.	20 22	♃ in ☐ with the ☉
9 36	☿ in conj. with Vesta, diff. of	21 7 27	Ecliptic conj. or ☉ new moon
	dec. 1. 52. S.	23 4 23	☿ in conj. with the ☿ diff. of dec.
10	☿ in Perigee		2. 9. N.
11 7 51	♃'s first sat. will im.	24 6 46	♂ in oppo. to the ☉
11 10 29	☿ greatest hel. lat. N.	25	Clock before the ☉ 12m. 32s.
14 1 18	☿ in ☐ or last quarter	—	☿ rises 10h. 1m. M.
15	Clock before the ☉ 9m. 33s.	—	☿ pass mer. 3h. 28m. A.
—	☿ rises 1h. 42m. M.	—	☿ sets 9h. 4m. A.
—	☿ pass mer. 7h. 3m. M.	26 7 0	☿ in Apogee
—	☿ sets 0h. 12m. A.	27 6 6	♃'s first sat. will im.
8 17	♃ in conj. with the ☿ diff. of dec.	27 23 21	♃ in conj. with the ☿ diff. of dec.
	3. 37. S.		2. 57. N.
17	☿ stationary	23 2 50	♃ in conj. with the ☿ diff. of dec.
—	Mercury, R. A., 18h. 27m. dec.		4. 57. N.
—	20. 21. S.	9 43	Pallas in ☐ with the ☉
—	Venus, R. A., 21h. 43m. dec. 15.	22 36	☿ greatest elong. 25. 3. W.
—	23. S.	29 10 34	☿ in ☐ or first quarter
—	Mars, R. A., 8h. 42m. dec. 22.	31	Occul. B.A.C. 1468, im. 12h. 50m.
—	47. N.		em. 13h. 50m.
—	Vesta, R. A., 21h. 24m. dec. 18.	—	Occul. ♂ Tauri, im. 15h. 7m. em.
	55. S.		15h. 59m.

THE
LONDON JOURNAL,
AND
REPERTORY
OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXLII.

RECENT PATENTS.

To CHARLES MORRY, citizen of the United States of America, Gent., for improvements in machinery for preparing, dressing, cutting, and shaping stone and other materials made use of for building purposes and architectural decorations,—being a communication.—[Sealed 10th May, 1851.]

THIS invention refers, firstly, to certain arrangements of machinery for dressing and shaping hard and soft stone, slate, marble, and other like granular substances; and, secondly, to the manufacture of the cutting-tools used in such or similar machinery.

In Plate III., fig. 1, represents in side elevation, and fig. 2, in plan view, an arrangement of apparatus intended to reduce the material from the rough state in which it leaves the quarry, and prepare it for the finishing action of the machinery hereafter mentioned. *a, a*, is the traversing bed of the machine, supported on parallel rails *b, b*; and *c, c*, are side standards, which carry the tools and the mechanism for working them. Mounted in bearings, in the cross-head of the standards, are three pinions, gearing into each other. The axle of the middle pinion carries a hand-wheel, for giving motion to the three; and the axles of the other pinions are elongated downwards, and threaded, for the purpose of taking into lugs, projecting from the under side of a sliding frame *d, d*, which carries the chipping-tools, and thereby affording a means of adjusting the frame to any desired elevation. In this frame are formed bearings for a crank-shaft *e*, which receives rotary motion from a steam-engine, or other motive power, by a strap and rigger, as shewn; and is governed, in

its rotation, by means of a fly-wheel. The shaft *e*, is provided with four cranks; but a greater or lesser number may be used, according to the nature of the work required to be accomplished. To each crank a chipping-tool *f*, is connected by a strap and brasses; and the throw of the cranks is so arranged, that the descent of the tools upon the work shall follow in succession, instead of being simultaneous. The tools *f*, work in a guide *g*, attached to the frame *d*; and they are furnished with flat springs *h*, which bear against the guide, and cause the tools to keep in contact with their work. Removable cutting edges are fitted to the tools, by entering a socket in the end thereof; and they are held in their places by a binding screw. These cutting edges are, by preference, serrated; and, being applied as described, they may, when worn or broken, be readily replaced by new ones.

From the above description it will be understood, that when rotary motion is given to the crank-shaft, the tools will be caused to strike, in succession, upon the upper surface of the stone, and chip off the rough protruding parts which it may present; and, by a slow traverse motion being given to the table on which the stone is fixed, the whole of the upper surface will be gradually brought under the action of the tools.

When the stone has been thus dressed, it is ready to be finished in the machine shewn in side elevation (being partly in section) at fig. 8. This machine is provided, like the former, with a traversing table *a*, for carrying the stone to be operated upon, which table rests on rails *b, b*, and is traversed by means of a worm *c*, keyed on to a shaft *d*, and taking into a rack *e*, attached to the under side of the table. The side standards of the machine are shewn at *f, f*; and they carry, at their upper end, a regulating apparatus, similar to that in the before-described machine, for supporting a vertical frame *g, g*, and determining the elevation at which it shall stand. This frame *g, g*, is connected to the side standards *f, f*, by means of screws, which pass through slots made in the framing; and it is provided with bearings for carrying a vertical shaft *h*, at the lower end of which the cutting-tools *i, i*, are mounted. These cutting-tools (which are termed "burrs") are discs of iron or steel, mounted loosely on axles, radiating from a common centre, and having their bearings in lugs, projecting downwards from a cross-arm or disc, attached to the lower end of the shaft *h*; and the peripheries of the burrs are serrated, to enable them to cut or reduce the stone by rolling over its surface. Keyed to the shaft *h*, is a

drum or pulley, over which a band, from any first mover, passes, for giving rotation to the burrs; and, by this means, the burrs are caused to roll over the stone and describe a series of parallel arcs thereon. Of these burrs there may be one, two, or more sets employed, according to the amount of power at the command of the operator.

Fig. 4, represents, in plan view, an arrangement of machinery for dressing two faces of a block of stone at one and the same time. This arrangement is intended principally for dressing grindstones; but it may also be used for preparing millstones, or other circular blocks of stone. *a, a*, is a rectangular frame, forming the bed of the machine; and, to one end thereof, a frame, furnished with two standards *b, b*, is bolted. These standards support a horizontal shaft *c*, which is furnished with driving-pulleys *d*, and carries, on its inner end, the stone to be dressed. Mounted upon V-rails on the bed-frame is a frame *e, e*, which is connected to the bed-frame by an adjusting-screw *f*, (furnished with a hand-wheel), taking into a vertical piece cast on the bed-frame. The object of this connection is to adjust the position of the frame *e*, with respect to the bed-frame, for the purpose that will be presently described. This frame *e*, itself, carries an adjustable frame *g*, the line of motion of which is at right angles to that of the frame *e*; and the relative positions of the two frames are determined by a screw *h*, which passes through one side of the frame *g*, and through a raised piece cast on the frame *e*. In the frame *g*, at one side, a slot is formed, to allow of a screw passing through to the frame *e*, below, and thereby effecting another connection, which will allow the upper frame to slide over the face of the lower frame when required. Bolted to the frame *g*, is a rectangular bracket-piece *i*, which carries two sets of burrs *k, k*, for dressing the stone. These burrs are mounted loosely on their axles, and are set at right angles to each other; and, by turning the screws *f*, and *h*, of the adjustable frames, they are brought up into contact with their work. Rotary motion now being given to the stone, through one of the driving-pulleys and the shaft *c*, the stone is made to rotate in close contact with the burrs, and is, by that means, reduced at its periphery and at one of its sides simultaneously.

It will be readily understood, that stones of various thicknesses may be expeditiously dressed by increasing the number of the burrs until they present a cutting or reducing surface equal in breadth to the periphery of the stone to be acted upon. Or, when stone for a shaft is required to be

reduced, the burrs which act upon the flat surface of the stone may be thrown out of action when they have dressed that surface, and a traverse motion may be given to the other set of burrs, in a line with the axis of the shaft, so as to bring the burrs into contact with the periphery of the shaft, after the manner of working the cutting tools in a self-acting lathe.

Fig. 5, is a side elevation of a machine in which the burrs are caused to act by impact; and fig. 6, is a front view of the same. The stone to be operated upon is supported on a traversing-table, composed of a rectangular frame *a*, with removable cross-bars *b*. When the stone is required to have an axial motion, these bars are removed, and the stone is supported by poppet-heads *c*, *c*, similar to those used in a lathe; and like means to that employed in such machinery is used for determining the amount of axial motion the stone is to receive, and for effecting the traverse of the stone under the burrs or cutting tools. *d*, *d*, are standards, connected together at top by a cross-piece, and carrying two adjustable sliding-pieces *d**, *d**, which form bearings for the axle *e*. Mounted on this axle is a drum *f*, around the periphery of which a series of curved plates *g*, with bracket-pieces cast on them, is bolted. These plates each carry a row of burrs, mounted loosely on axles, which have their bearings in the bracket-pieces of the plates; and the burrs are so arranged, that those in one row will "break joint" with the burrs in the neighbouring row; and thus the raised lines of stone left by the row of burrs which had last struck upon the surface of the stone, will be reduced by the action of the next succeeding row, and so on. The nice adjustment of the burrs to their work is effected by means of vertical screws *h*, *h*, which severally pass through a threaded piece bolted to the sliding-pieces *d**, and have their bearings at foot in a step provided for them, and at top in the cross-bar of the standards. Keyed to the upper end of these screws are the bevelled wheels *i*, *i*, which gear into, and are driven by, pinions *j*, *j*, on the horizontal shaft *k*,—by turning which, by means of the hand-wheel, the elevation of the sliding-pieces *d**, and, consequently, the position of the axle *e*, is determined. On one end of the shaft *e*, a driving-pulley is keyed, which, by means of a strap passing from any first mover, gives rotation to the shaft, and causes the burrs to strike in rapid succession upon the surface of the stone which is presented to their action. It will, of course, be understood, that these burrs must be set around the drum with great nicety, so that they shall be equidistant from the centre of motion, and thus all cut into the stone at

an equal depth, to produce a uniformly smooth surface. On the other end of the shaft *e*, is a pinion, which gears into another pinion on a vertical shaft *l*, which turns in bearings carried by the shaft *e*, and is capable of rising and falling therewith. It also works through a bearing *m*, and is intended to carry a cone-drum, over which a strap passes to another cone-drum, for the purpose of communicating motion to the table which carries the stone to be operated upon. This second drum is mounted on a shaft *n*, which has its top bearing in a bracket bolted to the side standard, and its bottom bearing in a sliding-plate *o*, which works in guides formed on the side standard. To the lower end of this shaft a worm is keyed; and, on either side thereof, a worm-wheel is mounted, the axles of which each carry a pinion in gear with the rack of the traversing table. When the stone is to be carried forward under the action of the burrs, the worm is thrown into gear with the larger worm-wheel by means of a lever *p*, connected by a link *t*, to the sliding-plate *o*, whereby a slow traverse motion will be communicated to the table. To reverse the direction of traverse of the table, the worm is thrown into gear with the smaller wheel, when the stone will be quickly carried back to its starting position.

Fig. 7, shews a modification of the above arrangement for mounting the burrs or cutting-tools, whereby burrs may be used for fluting columns; the stone having, in this case, an axial motion imparted to it at the completion of every flute, in order to bring a fresh portion of the periphery of the stone under the action of the rotating tools. It is obvious that any form of fluting or grooving may, by this means, be effected, providing no undercut is required. By substituting for the concave burrs, shewn in the drawing, others with a different sectional configuration, and applying them to a block of stone having merely a traverse motion, a great variety of grooving may be readily effected, whatever the shape of the block required to be acted upon.

The second head of this invention, which refers to the manufacture of the burrs or cutting-tools, consists in manufacturing them in an economical manner, with a case-hardened or chilled surface, whereby they will be enabled to resist to a certain degree the grinding action of the stone. It has hitherto been the practice to make these burrs of steel, and to rough their peripheries in the same manner that a milled edge is given to thumb-screws: that is, by rotating them in a lathe, and pressing against them a milled runner. In order to reduce the cost of manufacture, a metal pattern of the burr,

which is intended to be produced in quantities, is first prepared, and from it any required number of metal moulds are formed. Into these moulds molten iron or steel is run, whereby burrs are produced with great rapidity, having a case-hardened periphery, which is due to the sudden contact of the molten metal with the cold metal of the mould.

The patentee claims, First,—the arrangement of machinery for effecting the preparatory dressing of the stone, as above described. Secondly,—mounting the burrs or cutting-tools so that they shall work in a plane at a right angle to the axis round which they rotate. Thirdly,—mounting burrs or cutting-tools at a right angle, or any other required angle, to each other, so that they shall act upon two faces of the stone simultaneously. Fourthly,—the arrangement of the burrs or cutting-tools for acting by impact, as above described. And, Lastly,—the manufacture of the burrs or cutting-tools, by casting them in metal moulds, and thereby giving them a case-hardened or chilled cutting surface.—[Inrolled November, 1851.]

To ALFRED VINCENT NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in communicating intelligence by electricity,—being a communication.—[Sealed 3rd February, 1851.]

THIS invention consists in the use of such parts or arrangements of apparatus as will allow two or more persons, by the agency of electricity, to send or receive signals or intelligence by one common wire of communication or main conductor, whilst the rapidity or closeness in the order of succession of the signals, consequent on the indefinite short time the main conductor is in actual use in conveying the electric current for transferring the signals, shall be such, that all the persons so employed in these telegraphic operations can be continually and simultaneously occupied, in like manner as if each one of them had a distinct wire of communication all the time waiting for or appropriated to his particular use. By this invention the same practical telegraphic results are obtained, through the agency of one wire or main conductor, as, in the varieties of the electric telegraph before known or used, would require several distinct wires of communication.

According to this improved plan of working, the wire of communication or electric conductor may be considered as a

public word-road, or an omnitelegraphic way; whereas, in contradistinction, the conductor, as heretofore used, may be considered a private word-road, or a unitelegraphic way.

In addition to the ability of allowing divers parties simultaneously to telegraph at will, either all in the same or in contrary directions, over or along one wire of communication, this improvement enables each one of the operators, so employed, to have and to use as many distinct short wires or accessory conductors, all related to the main conductor, as the operators may desire to have separate signals; whereby the facility of making and receiving or recording signals or intelligence, is greatly increased. Thus, for example,—suppose ten men at each end of the wire of communication, are all using the same wire of communication which connects the distant places, their practical telegraphic facilities would be greater than could be had by the old system, if these twenty men had twenty different wires of communication in place of only one such wire, and would be as great as could be had by the old system, if each of these twenty men had as many such wires as they might desire to make or receive different signals. Thus, supposing twenty-five signals to be made and twenty-five to be received, for each of these twenty men, 1000 separate wires or main conductors would be required, in order to accomplish what, by the new system, requires only one such main conductor, aided by 1000 short wires or accessory conductors, or signal-making and signal-receiving wires, which need be of but a few inches in length severally, or so long as to reach to or be systematically put into electric relation with the respective ends of the main conductor or wire of communication; or otherwise, by motion, be successively brought into electric communication with, and so momentarily forming in succession, portions of the conductor, by which the electric current, circuit, or line of inductive action is established, maintained, or broken, from time to time.

It may be stated, that this improvement rests upon taking advantage of the circumstance that, practically speaking, no sensible portion of the time employed in working the telegraph is expended in the actual transmission of the electric influence, which is the medium or agent of the communications, but that it is due to the operation of making or recording the signals. One wire, reaching between the distant places, is therefore capable of being the instrument of transmitting an indefinite number of different signals in a second of time,—provided that suitable adaptations are made to enable so many different signals to be separately placed upon

one end of the main conductor, and received or recorded at the other end of the conductor in an intelligible manner.

There are an indefinite number of methods of applying to practice this improvement, differing more or less in kinds of apparatus used, and in modifications of electrical action applied. But all are substantially the same improvement; inasmuch as their action would be to set apart distinct and small and successive fractions of a second or other period, and assign and apply such small fractions of time to different uses or for different persons,—so that, although many persons should all simultaneously be employed in using one common wire of communication, yet all the signals, so transmitted by it, may be successive; the rapidity of the electric conduction admitting, by this invention, the divers signals to be transmitted successively along the wire, and yet so quickly, the one after the other, as to give a like practical result, as if they were simultaneously transmitted by separate wires or main conductors.

A convenient mode of applying this improvement to practice, and for illustrating the principle of the invention, may be understood by referring to the diagram, Plate III., wherein two pendulums, supposed to be actuated by clock-work or other suitable means, are indicated; such pendulums being made to vibrate as nearly as possible together in position and in time of vibration. At the chief station A, the standard pendulum is situate; and the dependent telegraphic stations are also provided with a pendulum, as at B. D, D, are the pendulum rods, with their balls or weights; E, the prolonged end of the pendulum rods, which should be much longer, in proportion, than represented in the drawing; F, slight springs, united to the prolonged end of the pendulum rods; and P, B, P, and P, S, P, are two grooves or pathways, so made that the springs F, shall fall into the groove P, B, P, when the pendulum makes the vibration from left to right, and shall fall into the groove P, S, P, when making the vibration from right to left. C, C, is the main conductor or wire of communication, connecting the two telegraphic stations A, and B, together. x, x, are ground plates and ground wires. At station A, there are metallic points, over which the spring F, passes, touching the surface each vibration,—which points are connected with the conductors L, x. The groove P, B, P, at station B, is of metal, and in electric communication with L, and x. The spring F, in moving in either of the grooves P, B, P, or in the groove P, S, P, of station A, is kept in its path by an insulated or non-conducting guide. z, is a Leyden

jar, prime conductor of an electrical machine, or galvanic pile, kept constantly charged, or capable of giving a great number of visible sparks or electric pulsations per second, on making or breaking the electric circuit or line of inductive action. The wire *c, c, c*, has a metallic connection with the upper end of the pendulum rods, which are also metallic, as well as their prolonged terminations. In this condition of things, whenever the spring *r*, at station *A*, passes over *k, k*, in its vibrations, there will be an electric communication or circuit from *z*, to *κ*, through *L, x*, to the ground at station *A*; also from *z*, to the metallic groove *r, r, r*, at station *B*, and to the ground there;—provided the pendulum at station *B*, is making its vibration from left to right, when the pendulum at station *A*, carries its spring *r*, over the conducting point *κ*. At *κ*, on the left-hand side of the standard pendulum, there are two metallic faces near together: by this arrangement it can be known at station *B*, when the pendulum at station *A*, is in motion, and the position of its vibrations exactly determined; so that the pendulum at *B*, can be from time to time set in motion, accelerated, or retarded, in order to maintain that degree of synchronism in the action of the pendulums, and similarity in position, which are necessary for the success of the telegraphic operations. When the pendulum at *B*, is correctly timed in its motions, there will be visible two sparks on the left-hand side, and one spark on the right-hand side of the conducting groove at *κ, κ*, station *B*, equally distant from the centre of vibration; but when this pendulum is not in its proper position or motion, these sparks can be seen at other places along the groove. *H*¹, and *H*², at both stations, are signal-making wires; and *G*¹, and *G*², at both stations, are signal-receiving wires. These signal wires are to be supposed as numerous in each set as the number of different signals desired to be used—say not less than the letters of the alphabet; a smaller number is, however, shewn in the drawing, for distinction sake. All the signal-receiving wires reach into the groove or path-ways *r, s, r*, in such a manner that the spring *r*, shall touch and slide over the flattened faces or ends of these wires in succession, each time the pendulums move from left to right. The signal-making wires, on the contrary, stand a little off, out of the groove or pathway, but are intended to be so mounted, that each may be raised by the pressure of the finger, and brought into the line of the groove or path-way, to be touched by the spring *r*, when the pendulum swings from left to right. All these signal wires are united by one end to the conductor *L, L*, but are free and independent at the other end. The free

end of the signal-receiving wires may have a width of half an inch, more or less, where r , passes over them. The corresponding ends of the signal-making wires may be but an edge or line; so that the signal-making wires can be touched by r , but for a moment, whilst the signal-receiving wires will be touched for a sensible time by r , in passing over them.

Under these circumstances, if any one of the signal-making wires H^1 , at station A , be touched, and brought into contact with the end r , of the vibrating pendulum, a conducting circuit or electric current will be established for the moment through the whole system of conductors; for, at that moment, the corresponding pendulum at station B , will be in front of the group of signal-receiving wires H^1 , of that station. Therefore, from the electric circuit existing for that moment of contact, there would be a spark visible upon the flattened end of that one of the signal-receiving wires which corresponded to that one of the signal-making wires at the other station which may have been pressed upon and brought into the path-way of r ; all these signal wires in each set being marked by and signifying the different letters of the alphabet, &c. It is obvious, that if the left-hand wire of each set be marked a , the next b , next c , &c., then, should a , b , or c , of a signal-making group H^1 , station A , be pressed upon and touched by r , this act will be known at station B , by the appearance of a spark on the end of that one of the signal-receiving wires a , b , or c , of group H^1 , station B , corresponding to that wire which may have been so touched at station A . Thus, at will, can any signal or letter be sent from station A , to station B , and, during the operation of signal making, by one person at station A , to another at station B , by the use of the wires H^1 , at each station. It will now be seen, that another person, or the same person at station B , can telegraph in reply to station A , by making use of the set of wires G^1 , of each station, in a manner similar to that in which the wires H^1 , before described, were used. Suppose that the time of a double vibration of these pendulums is equal to the time necessary for conveniently making and observing a signal:—Then, by the use of the four sets of signal wires above named, a person may send to or receive signals from or between the stations A , and B , reciprocally; or four persons may be continually and simultaneously employed in making and receiving signals at each station. The use of these signal wires referred to, as able to employ four persons in continual telegraphic intercourse, will in no way interfere with the simultaneous employment of two or four other operators using the

other signal wires on the right-hand half of the vibrations marked π^2 , and σ^2 ; so also, by lengthening out the ends of the pendulum rods, or increasing the angular motion of the pendulums, more space or places may be had for carrying out a larger number of telegraphic operations indefinitely.

It has been said, that the pendulum at station π , may be kept adjusted to the motions of the regulating pendulum, by the appearance of sparks at π , κ ; but this synchronism may be more perfectly maintained by using any of the known forms of electro-magnets.

In the above illustration the electric spark from an electrical machine has, for simplicity, been chosen as the visible signal; but, should it be desired to make signals by the hydro-electric current and the deflection of a needle, then each one of the signal-receiving wires, before uniting with the common conductor L , may be lengthened out sufficiently to form the coil of a galvanometer; and the current passing through any one of these wires can make itself known, or a signal be so given by the deflection of the needle of the galvanometer belonging to that particular signal-receiving wire so signalized. Or, in like manner, these prolonged signal-receiving wires may each one enclose a bar of iron in place of a magnetic needle, so as to have an electro-magnet and keeper belonging to each one of these wires: then the passage of the current through any of the wires may give magnetism to the bar, or actuate the magnet or its keeper; and from this motion the signals may be perceived, or recorded and printed in any convenient form.

From the above explanations it will be obvious, that divers stations and complex systems of telegraphic lines of communication can be established on the principle of this invention; and it will also be understood, that the invention is susceptible of an indefinite number of modifications or forms, as respects the apparatus employed in carrying it into use.

The patentee claims, rendering available the conducting power of electric telegraph wires, so that they may transmit one or more electric currents (in the same or opposite directions) during the time that must necessarily elapse between the transmission of succeeding signals which have reference to one and the same communication.—[Inrolled August, 1851.]

To GODFREY ERMEN, of Manchester, cotton-spinner and manufacturer, for certain improvements in the method of, and apparatus for, finishing yarns or threads.—[Sealed 17th June, 1851.]

THESE improvements in the method of and apparatus for finishing yarns or threads, are intended chiefly to be employed for finishing "sewing cotton," or cotton threads used for such purpose; but they are likewise applicable to the finishing of linen, silk, or other yarns or threads. The object of the invention is to give to such threads a perfect smoothness and unity or adhesion of the fibres, and at the same time impart to them a lustre or gloss; and this the patentee effects by the application of friction, by means of a brush or brushes, to the threads when in the hank, and whilst in a state of tension and motion.

A vertical section of the apparatus used in carrying out this invention is represented in Plate IV. The framework of the machine consists of two side standards *a*, connected by horizontal bars *b*. The main driving-shaft is shewn at *c*; it works in bearings, supported by one of the standards *a*, and by a frame or bracket *d*, affixed to such standard; and it is put in motion by an endless band, from any first mover, passing around a pulley *e*, upon it. The shaft *c*, carries a pinion, indicated by the dotted circle *f*, which gears into a toothed wheel *g*; and on the boss of this wheel is fixed a pinion *h*, that gears into the toothed wheel *i*. The wheel *g*, and pinion *h*, turn upon a stud carried by the lever *j*; by means of which lever the wheel *g*, can be moved into and out of gear with the pinion *f*; and as the fulcrum or axis of the lever is in a line with the shaft of the wheel *i*, the pinion *h*, will, consequently, at all times remain in gear with the wheel *i*. On the side of the lever there is a small pin, which, when it is desired to keep the wheel *g*, in gear with the pinion *f*, is caused to enter the upper part of a slot in a pendent lever *k*: this slot is of such shape as to admit of the end of the lever *j*, being moved outwards to a sufficient extent to throw the wheel *g*, out of gear with the pinion *f*, when the lever *j*, is released by slightly raising the lever *k*. *l*, *m*, are the rollers that carry the yarns or threads *n*, to be finished. The lower roller *l*, is connected with the shaft of the wheel *i*, by means of a clutch-box,—one half of which is formed on the end of the roller, and the other half on the end of the shaft; and this arrangement admits of the roller being readily detached from and again connected to the shaft, so as to rotate there-

with. The upper roller *m*, turns in hooked bars or bearings, suspended from the under side of a horizontal bar *o*, which is capable of sliding up and down between the side standards of the machine.

The bar *o*, is raised and lowered by the following arrangement of mechanism :—On the shaft *c*, there is a bevil pinion *p*, gearing into a similar pinion *q*, on the lower end of a vertical shaft *r*, which extends to the top of the machine, and carries, at its upper end, another bevil pinion, standing between a pair of bevil pinions, mounted on a horizontal shaft. The two pinions are fixed to a short hollow shaft, which is placed upon the shaft just named, and is capable of sliding lengthwise thereon ; but the two shafts are caused to rotate together by a feather upon the long horizontal shaft entering a groove in the interior of the short shaft ; and, by means of a small hand-lever, the short shaft may be slidden to and fro, according as it is desired to put one or other of its pinions in gear with the pinion of the shaft *r*, (so as to give motion to the long shaft), or to place both pinions out of gear with the latter pinion. The long horizontal shaft carries at one end a pinion *s*, which gears into a pinion *t*, fixed on the boss of a spur-wheel *u* ; and from this wheel motion is transmitted through a pinion *v*, to another spur-wheel of like diameter. The bosses of these spur-wheels have female screws formed within them, to receive the screws *w*, connected to the bar *o* ; and hence, according as the spur-wheels are made to rotate in one direction or the other (by the mechanism above described), so will the bar *o*, be raised or lowered.

x, is the rotary brush that acts upon the threads : it is fixed on a shaft *y*, which carries a pulley *z*, to receive an endless band from the first mover, whereby the desired rotary motion is imparted to the brush. *x*¹, is a rotary fan, driven by a band passing around a pulley on its axis, and employed for the purpose of subjecting the yarns or threads to the action of a current of air during the finishing operation.

The mode of finishing yarns or threads, by this machine, is as follows :—The hanks of yarn, after being bleached or dyed and properly dried in a stove (or in the unbleached state), are immersed, for a short time, in a vessel containing starch or size ; on their removal from the vessel, the superfluous starch or size is wrung or squeezed out, and the hanks are spread out as evenly as possible upon the rollers *l*, *m*, (which have been removed from the machine for that purpose, and placed in a frame or stand) ; and then the rollers are replaced in the machine, and set in motion. The yarns

or threads being now slack, the bar *o*, and upper roller *m*, are raised, by the means above described, so as to bring the threads to the requisite degree of tension. The fan *z*¹, is now caused to revolve, and the rotary brush *x*, is set in motion. As the threads become slack from time to time, during the operation, they are tightened up again by raising the bar *o*. When the threads have attained the required gloss and smoothness, the operation is complete; and then the bar *o*, is lowered until the threads are sufficiently slack to allow of the rollers *l*, *m*, being removed from the machine.

The patentee claims, First,—the producing or imparting a lustre and smoothness, together with perfect adhesion of fibre, by the application of friction to yarns or threads in the hank, and whilst in a state of tension and motion,—such friction being produced by means of a circular or endless brush or brushes. Secondly,—the peculiar arrangement of machinery or apparatus for effecting the said object, as represented and described.—[Inrolled December, 1851.]

TO RICHARD JEX CRICKMER and FREDERICK WILLIAM CRICKMER, of Page's-walk, Bermondsey, engineers and co-partners, for improvements in packing stuffing-boxes and pistons.—[Sealed 3rd July, 1851.]

THIS invention consists in a mode of combining the use of metal, at the places where there is friction and motion, with flexible and elastic material in packing stuffing-boxes and pistons.

In Plate III., fig. 1, is a plan view, and fig. 2, a side elevation of the packing for a stuffing-box, constructed and arranged according to this invention. The inner portion of the packing, which will be in contact with the piston-rod, consists of several metallic rings *a*, made, by preference, of wire cloth; next to these are placed some rings *b*, of canvas, prepared in the manner hereafter described; the latter are encircled by a ring *c*, of vulcanized India-rubber; and this ring is surrounded by some more rings *d*, of prepared canvas. The packing is divided on one side by an inclined cut (as shewn at fig. 2.), in order that it may be placed around the piston-rod without it being necessary to remove the cross-head therefrom. The elasticity of the India-rubber ring *c*, serves to keep the metal surface *a*, of the packing, in close contact with the piston-rod.

Fig. 3, is a plan view, and fig. 4, a side elevation of an

improved packing for a piston. In this case, as the friction will be at the outer surface of the packing, the metallic rings *a*, are placed on the outside; and such rings are, for this kind of packing, preferred to be made of perforated sheet metal. Rings *b*, of prepared canvas, are placed within the rings *a*; inside the rings *b*, is the ring *c*, of vulcanized India-rubber; and this encloses the rings *d*, of prepared canvas. By the elasticity of the India-rubber ring *c*, the outer metallic surface *a*, of the packing is kept at all times in close contact with the interior of the cylinder in which the piston is working.

The patentees prepare the canvas by saturating it with the following composition; but they do not confine themselves to the use thereof:—They melt sixteen parts of grease or fat, and then stir in a powder, consisting of three parts of black-lead, two parts of sulphur, and one part of alum; and with this composition they saturate the canvas or other woven fabric or fibre employed in carrying out this invention.

In conclusion, the patentees state, that they do not confine themselves to the above details; but they claim the mode, above described, of combining metal with flexible and elastic substances for packing stuffing-boxes and pistons.—[*Inrolled January, 1852.*]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in engines to be worked by steam or other power,—being a foreign communication.—[Sealed 7th December, 1850.]

THE improvements embraced by the present invention relate, first, to the form of the openings through which the steam passes; secondly, to the freedom with which the governing valve moves; thirdly, to the range of the movements allowed to the governing balls of the revolving pendulum or governor; fourthly, to the means of regulating the total range which the valve can take over the opening between the extreme positions allowed to the governing balls, according as the whole or a part only of the power of the engine is to be brought into use, or as a higher or lower pressure of steam is to be carried in the boiler; fifthly, to the employment of a spring set-screw, by which a greater amount of steam is admitted when the tension becomes less, or as the valve opens,—thereby preventing too great a draught of the balls or reduction of speed.

The valve-openings are formed in such a manner that, while the spaces left open by the valve at any two moments shall bear to each other an arithmetical ratio, the lengths of line along the edge of the valve, where it comes to the opening, have, at the same two moments, a ratio increasing more rapidly than the valve retires.

This is done upon the principle that the greater or less the amount of machinery or of work to be regulated, the greater or less is the addition or diminution in the quantity of steam which, in any indefinitely short space of time, ought to flow through the governor valve, in order to effect that regulation. As an example of this it may be stated, that to give an additional revolution per minute to one hundred tons of machinery, will require more increase of valve-opening, during the time that the speed is increasing, than would be required to give the same increase of speed to twenty tons of machinery driven by the same engine. But if the valve-opening were of uniform breadth, and the valve moved over it at a uniform rate—that is, if it uncovered the same space in the same time, whether the engine were running light or fully loaded—the control which would be exerted over the work under the lighter load might be sufficiently prompt, while over the heavier it might be too sluggish and inefficient; or, if rapid enough for the larger load, it might be found to give a violent jump to the smaller.

The form and proportion of opening which the inventor proposes to employ, for steam at a pressure of fifty pounds per square inch, are given in Plate IV., at fig. 4; and for pressures below these, a corresponding increase of opening, or a large disc, in which similar openings are made, is employed. Where long lines of shafting or other permanent machinery, involving much friction, is attached to the engine, the plain line a, a^1 , fig. 4, may be replaced by a line giving a larger opening, which may vary as far from a, a^1 , as the dotted line f, f^1 ; and, in cases of extraordinary lightness and ease of running, the line a, a , may, on the other hand, vary so as to narrow the opening to the limit of the dotted line g, g^1 , and the line may run from f^1 , to g^1 .

Although the disc is the best form for the valve-seat, yet sometimes valves may be constructed so that their seats shall be in the curved sides of a cylinder or cone; but the principle on which they open will still be the same; and the same law will be observed when the valves are made to slide instead of rotate or move on a centre. The principle of the present improvements is applicable to a valve moving over an opening

of uniform breadth ; but, in this case, the valve will be made to move with greater rapidity when nearly open than when nearly closed ; whereby a greater amount of opening will be uncovered in the same time near the full open end than near the fully closed end of the passage.

Besides the irregular and dangerous action of the engine, arising from a too rapid opening of the governor valve at one time, and too slow an opening at another, there is with the valves in common use another source of disturbance or of sluggishness in action requiring to be corrected, and demanding, for the prevention of sudden alterations in speed, a combination of the form of opening with adequate means to render the correction prompt, in order to make the movements of the valve, over its openings, coincide in time with the demands of the work. The resistances created by the friction of a valve upon its seat or bearing, and on the packings by which it is secured, and by its adhesion to the sides of the tube or box within which it is made to work, require ordinarily a considerable force to overcome them. They will require a decided increase of speed in the governor balls before their tendency to expand will begin to open them ; and an equal diminution of speed to allow them to descend when resisted by the causes just pointed out.

The manner in which the inventor prefers to diminish the friction of the valve on its seat is shewn at fig. 1. *A, A*, represents the spindle and valve-cover ; *B, B*, the valve-seat, drawn against the shoulders *o, o*, by the nut *c*. *D, D*, are the flanges to which the steam-pipe is attached ; *P, P*, is the side pipe ; *E*, the cap, which is to be taken off when the valve is to be examined or taken out ; *A*, is the arch that holds the spring set-screw *e, e*. The valve is worked by a rod attached at *c**, and connected with the governor. *d*, is a steel pivot, at the end of the spindle *A*, and rests against the hardened surface of a piston or plug *K*. The valve-cover is now pushed back, and a leak takes place between it and the seat. In this position of the valve-cover the steam is low, or, if not, the valve is nearly open, and the engine working up to full power ; and when the machinery is detached, the space between the valve and its seat will become narrower, as the balls rise and close up the apertures, causing a greater pressure against the piston *K*. When the piston *K*, is pushed back against the cross-pin *n*, the valve-cover should not touch the valve-seat, but be near enough to prevent a leak between them ; the whole pressure always resting on the piston *K*.

In order to provide against a contact of surfaces, by reason of any springing of the valve under the pressure of steam, and to insure the free action of the valve, whether more or less closed, the shaft of the screw *e*, is made hollow, and the follower *g*, placed within it, and made to act on a spring *s*, which, in turn, acts on the piston *κ*; this piston has a short slit in it, through which passes the pin *n*, allowing a very limited movement of the piston. When pressed fully out by the spring, the piston *κ*, projects a short distance beyond the end of the screw *e*. The adjusting screw *e**, forces forward the follower *g*, compresses the spring *s*, to such a degree as will enable it barely to yield to the pressure of steam, and brings the valve nearly in contact with its seat, when it covers the whole opening, but which will raise it slightly away from the seat as the valve opens, and when the effective pressure tending to keep it to its seat is no longer felt.

To make the range of motion of the governor balls most advantageous for the prompt and effective opening and closing of the valve, these movements are confined to the higher parts of the arcs through which they are capable of rising. It being well known, that the time in which a conical pendulum will revolve is determined by the vertical distance of the balls below their point of suspension, the length of the suspending-rods is so calculated as to make the balls begin to rise, with the speed which they will have when the engine runs at the working rate, above 40° from their perpendicular positions; and when they are running at the greatest speed, they are allowed to rise as high as 70° or 75° . As the centrifugal force of the balls, when they expand 45° , is equal to their gravitating force (and when they rise above that elevation the centrifugal exceeds the gravitating force), the higher range at which the balls revolve will give them a steadier action than the lower; and it is most advantageous to let the whole governing power of the balls be confined to a range of 15° or 20° , say from 50° to 70° ; so that, when at the former height, the valve shall be at its limit of widest opening, and at the latter, shall be at a nearly full closure. The length of the rods of the governor, and the relation of the arms of the governing lever, are so arranged, that an acceleration of about four per cent. above the prescribed speed of the engine will close the governor valve, and a falling off to the same extent below the prescribed speed will leave the valve wider open. The manner of effecting this adjustment is to slide the rest *c**, on the valve-lever *c*, (figs. 1, and 2,) to such a distance from the valve-stem as will make the prescribed range of

motion of the balls move the valve over the whole range of the valve-opening required at the time.

To determine the range which the valve shall take over the opening, the valve-lever *c*, (figs. 1, and 2,) is furnished with a set-screw *r*, whereby its position on the valve-stem may be regulated, so that, when the governor balls are perfectly at rest, the valve-opening will be either wholly uncovered or but partially so, according as the whole power of the engine, or only a portion of it, is to be brought into operation. For the purpose of adjusting the lever *c*, so as to give the valve the required set, according to the quantity of work which the engine is intended to perform, the valve-stem is furnished with an indicator *f*, which shews the amount of opening at every position, and whether the valve-lever be set in one position or another on the stem. This indicator, in combination with the adjustable valve-lever, is likewise useful in regulating the amount of opening of the valve, according to the pressure of steam which it is intended to maintain in the boiler while the amount of work is constant. It is convenient, but not indispensable, that the number of valve openings in the same disc (as seen in fig. 4,) should be confined to two. The same amount of space, with a like disposition in regard to the opening of the valve (with increasing rapidity the wider it is opened), may be preserved, into whatever number of parts the open space is distributed. It will be observed, that the arcs *f*, *f*¹, *a*, *a*¹, and *g*, *g*¹, are not portions of perfect circles, but that the curvatures have a shorter radius near the centre *m*, of the valve-seat than near the periphery *r*. If the openings be divided into three parts, or any greater number, the rapidity of increase in the rate of opening may be made greater than when the whole of the space is distributed between two openings only; but an opening, in which the length should be materially less in proportion to the breadth than is seen in fig. 4, would be objectionable, on account of the greater variation which would be occasioned by a slight looseness in the joints of the lever and connecting-rod, or which might result from accidental motion or joining of the engine.

Fig. 2, is a view of a balanced valve, with two discs *a*, *a*, similar to fig. 4, and shewn detached in fig. 5. *b*, *b*, is the cover of the apertures, shewn detached at fig. 6, and is attached to the valve-stem *c*¹, fig. 2. This valve works 90° (the same as fig. 1.), and, in cutting off steam from the engine, the large end of the aperture closes towards the smaller, in the direction of the arrows marked in figs. 4, and 5.

In fig. 8, the position of the governor arms r , 40° , r , 70° , &c., indicates the range generally found to act most advantageously on a frictionless valve, having openings of the nature of the present invention; the lines r^1 , g , and 40° , g^1 , indicate respectively the gravitating force and the centrifugal force when the balls are on the lowest limit of the range; and the lines r , g^5 , and g^1 , 5^1 , 70° , shew the relation of the same forces to each other when the balls are at their highest range.

In fig. 4, is given the card of an indicator (f , fig. 1.), so divided as to denote the proportionate part of the space opened by the valve, and enabling the engineer to adjust the amount of opening which he requires.

Fig. 7, represents a governor B , B , adapted to a valve of the improved form. The governor is connected by a lever c , and rod D , to the cam E , which vibrates on the centre A . r , is the lever of the oval valve H , H ; and G , is a pin, attached to the lever r , and sliding in the cam-slot or inclined plane j , j . It will be seen that as the balls of the governor drop, the rod D , will rise, and thereby cause the slot to move round and open the valve H , H , by drawing the lever r , to the position represented by the dotted lines. The motion given to the valve will be represented by the angle c , c , c . That angle should vary with the size of the valve, and also with the greater or less angle at which it is set with the sides of the pipe.

A similar form and arrangement of cam to that represented at fig. 7, is shewn at fig. 8, as applied to work a balanced water-gate for a water-wheel. When the balls of the governor drop, the lever B , descends to c , and the slot j , j , being made to work the gate, by means of the rod r , the gate will be raised or lowered, so as to admit or stop off the water in the proper proportion, as mentioned. The gate is balanced, so as to act in the following manner:—As the balls drop, the gate D , drops, and allows water to flow over, and is consequently relieved of some of its pressure: the weight E , that balances the gate, moves towards G ,—decreasing its leverage in the same proportion as the pressure is taken from the gate by its dropping.

Fig. 9, shews an arrangement of the rods and levers of the governor, to reduce the motion of the valve when nearly closed: this arrangement could be applied to water-wheels as well as to steam-engines. It will be seen, that as the balls rise high (as represented in the drawing) the levers of the arms c , c , are nearly perpendicular,—making the three pivots j , j , j , nearly on the same line; and the motion of the slide B ,

on the rod *d*, is thereby greatly diminished: when the balls drop, the motion of the slide *b*, increases rapidly. In order to adapt this increase of motion to the old valve, it has been found desirable to employ the following combination:—Attached to the valve-lever *e*, is a long rod *b*, which is also connected by a rod *e*, to the pendent rod *a*. The rod *b*, passes through the guide *d*; and the rod *f*, forms a connection between the rod *a*, and the bearing *j*. It will be seen, that as the rod *a*, is drawn up, the rod *b*, will be moved to the right, and open the valve very slowly at first, but more rapidly as the movement proceeds. At fig. 10, the form of opening of the oval valve, shewn at fig. 9, is represented as being in a flat or plane: the dotted parallelogram represents the cover, which, when drawn off towards *k*, by a uniform motion, shews the opening of that kind of valve as it is now attached to governors for steam-engines.

A valve having a uniform aperture, or nearly uniform in width, should be moved by an accelerated motion (as the balls drop equal distances), as represented by the spaces between the lines of fig. 10; and if the aperture is of the form shewn at fig. 11, the motion of the valve-cover should be uniform, as the balls drop equal distances.

The alternate slow and fast motion that takes place when the engine or water-wheel is running with a light load, is occasioned by the following causes (see fig. 12):—Suppose an engine or water-wheel running against a resistance of fifty-horse power, and you suddenly increase the resistance by ten-horse power, the motion would be checked four times as much in the same time, say from *a*, to *b*, as it would if it had been working against a resistance of 40-horse power; the balls will consequently open the valve to an extent four times greater, while there is but one fourth of the resistance or inertia of machinery in motion to resist that four times greater power let on suddenly. The consequence is, the engine or wheel takes a sudden start with the light load, and a part of that extra power becomes latent in the moving machinery while the speed is going up to *c*. That latent power or momentum begins to operate at the point 1, and carries the speed up to *c*; the valve closes nearly or quite at *c*; and the extra momentum being expended, and the valve nearly closed, the motion goes down so suddenly, that the opening of the valve cannot overcome the disposition it has to come to a state of rest, until it passes the line *a*, and goes down to *d*. At that point the great amount of power let on by the valve starts the speed up again to as high a point as it arrived at before,

and it continues to oscillate in this manner. The short line *a*, indicates the average speed when 10-horse power resistance was driven; but adding 10-horse more brought the speed down to the line *b*. The first depression of speed was greater than the following,—occasioned by the steadying power of 20-horse being more than 10-horse. Now it is evident that, if the 40-horse resistance had been thrown upon the engine when the 10-horse power was added, the motion would not have fallen off but one fourth as much, or it would only have varied in motion as represented by the waved line 2, 2, when compared with the average line *a*, *a*¹. In fact, the vibration would have been less than that, because the steadying power of the machinery added on, increases faster than the regular amounts of machinery are added. The form of opening in figs. 4, and 11, is a representation of both. The area included within the dotted lines lengthwise represents the machinery added; and the area included between the black lines represents the steadying force of the same. The above is an explanation of what should be understood when it is said that the proportion of the apertures should be in proportion to the momentum to be regulated, or the inertia to be overcome: a difficulty always troublesome with the old valves, in proportion as you change suddenly a greater amount of resistance, or as you are anxious to work the valve more quickly.

Fig. 10, is a drawing, representing the area of opening made by the oval valve. At fig. 7, the perpendicular distance that the valve drops from the pipe, when opened equal distances, at the end of the lever *r*, are nearly equal: see points 1, 2, 3;—corresponding points 1, 2, 3, are also shewn at fig. 10. The lines *a*, *a*, *b*, *b*, *c*, *c*, represent the edge of the valve on one side of the stem moving away, so as to admit steam. The points 4, 4, represent the distance equal to half the diameter of the valve. The spaces contained between the lines *a*, *a*, *b*, *b*, *c*, *c*, represent to the eye how fast the valve opens at the points 1, 2, 3: it will be seen that it is almost a uniform opening, and a very wide one, the spaces between *a*, *a*, *b*, *b*, *c*, *c*, being almost equal.

The patentee claims, First,—making the valve-openings of governor-valves to widen from the closed towards the fully open end, and also, in such a manner, that when the governor acts upon the valve under low speed, it shall cause the opening or closing of that part of the steam-passage where the widening or narrowing of the passage is more rapid than at the parts on which the valve acts at high speeds. Secondly,—forming valve-openings substantially as described in fig. 4, whatever

may be the number of openings into which the space or valve-seat is divided, and whether the said openings are made in plain or curved surfaces. Thirdly,—the spring set-screw, reacting against the pressure of steam on the valve-cover, not only for relieving the valve from friction, but also for causing it to recede slightly from its seat, when the valve approaches its open position; whereby an increased flow of steam is permitted, and the rate of flow augmented the more the valve opens, or the tension of steam diminishes, as herein set forth. And, Fourthly,—in combination with a valve-lever, adjustable to the stem of the valve *a*, an indicator, not adjustable, for the purpose of setting the valve in any required position without opening the valve-box.—[Inrolled June, 1851.]

To WILLIAM CRANE WILKINS, of Long Acre, in the county of Middlesex, engineer, for certain improvements in railway buffers.—[Sealed 29th May, 1851.]

THE subject of this invention is an improved buffer for diminishing, or altogether neutralizing, the injurious effects arising from the concussion of carriages on railways. The improved buffers are to be employed as auxiliaries to the ordinary buffers; they are to remain in a state of inaction during any minor or slight cases of concussion; and are only to come into use when the force of collision is so great as to overpower the springs of the ordinary buffers. The peculiar feature of novelty which characterizes this buffer is, the interposition of sand as a resisting medium to the force of severe concussions.

In Plate IV., fig. 1, is a plan view and fig. 2, a side view of part of the under framework of two railway carriages, shewing the application thereto of the improved buffers *a, a*. Fig. 3, is a vertical section and fig. 4, an under side view of one of the buffers on an enlarged scale. The case *b*, of the buffer consists of two or three thicknesses of sole leather; or, if preferred, gutta-percha may be used for the inner casing. The outer covering is so constructed as to envelop five of the sides of the buffer, and to serve as the means of connecting the same to the framework *c*, of the carriage. For this purpose, portions *d, d*, and *e, e*, of the leather extend beyond the buffer, and are secured to the transverse beam of the framework by bolts and nuts *f, f*. Metal plates *g, g*¹, are placed between the heads and nuts of the bolts and the leather, to distribute the pressure or hold over the whole width of the leather; and the plate *g*¹, projects some distance beneath the

buffer, so as to support the same. An extra thickness of leather *h*, is applied to the front of the buffer, in order to impart additional strength thereto. The case *b*, is filled with sand through a nozzle at *i*, which is afterwards covered by a cap *j*. The patentee prefers to use the ordinary sand of the sea-shore, because its grains are of more uniform size than those of other kinds of sand. The sand must be perfectly dry before it is introduced into the case.

On the power of the ordinary buffers *k*, being overcome, they will be driven home to such an extent that the opposing faces of the sand-buffers *a*, *a*, will come in contact with each other, and receive the excessive force of the shock. The patentee remarks, at this part of his specification, that "the granular nature of sand renders it capable of arresting projectiles or bodies in motion, and, applied as a medium for the resistance of concussion in railway carriages, it will prevent the violent transmission of concussion from one carriage to another, by absorbing a great portion at least of the force."

The improved buffers *a*, are shewn attached to the end of the carriage-framing between the ordinary buffers *k*; but, in new carriages, this may be varied according to the judgment of the builder; as, if the position of the buffers *a*, and *k*, be reversed, the concussion would perhaps be less likely to affect the framing. Although the patentee prefers to use the sand-buffers as auxiliaries to the ordinary buffers in passenger trains, he reserves to himself the right to use the improved buffers, either alone or in combination with the ordinary buffers, for passenger and goods carriages, or in railway trucks. What he claims, as an improvement in railway buffers, is, the use of sand interposed as a medium for the reception of some of the force resulting from violent concussion, with a view to prevent, as much as possible, the transmission of such force through the train.—[Inrolled November, 1851.]

To PIERRE ARMAND LE COMTE DE FONTAINEMOREAU, of South-street, Finsbury, London, and Boulevard Poissonnière, Paris, for certain improvements in electric telegraphs,—being a communication.—[Sealed 3d May, 1851.]

THIS invention consists in the application to electro-telegraphic apparatus of a key-board, similar to that of a piano-forte, in conjunction with a toothed cylinder, combined with a ratchet-wheel and lever, put in motion by the keys, whereby it is

merely requisite to place the finger upon a series of keys, on which signs, letters, or numbers, are written, to effect the transmission of intelligence.

In Plate III., fig. 1, is a vertical section, and fig. 2, a plan view of so much of an apparatus for transmitting signals by electricity as appertains to this invention. *d, d*, are keys, similar to piano-forte keys, which are capable of moving up and down upon a supporting bar *b*; and each key is furnished on the under side, near the middle of its length, with a small projecting piece or catch *c*. Under the keys, and at right angles thereto, is mounted a horizontal steel cylinder or shaft *a*, having stops or teeth *e*, projecting radially therefrom, and arranged in a helical direction around it. One stop is fixed to the cylinder beneath each key, in such a position that, when the cylinder revolves (which it is caused to do by clock-work), the stop will, once in each revolution, pass beneath the catch *c*, of its corresponding key; and, in the event of such catch having been brought down by depressing the key, the stop will be detained thereby, and the revolution of the cylinder stopped, until the key is permitted to rise again. On one end of the cylinder is fixed a ratchet-wheel *f*, into the teeth of which the end of a small lever or pawl *g*, enters, and so prevents the cylinder from revolving, except at such times as its end is raised out of the teeth of the ratchet-wheel. In order that this may be effected when any key is pressed down, a long bar *h*, is provided, which extends beneath the whole of the keys, and fits close to the under surface thereof, so that it will be depressed when any key descends; and as the hind end of the pawl projects beneath the bar *h*, it will be simultaneously pressed down, and its opposite end lifted out of the teeth of the ratchet-wheel: on the pressure being removed from the key, the bar *h*, is raised to its former position,—no doubt by the action of springs; but the specification does not enlighten us on this point.

The patentee does not state of what material the keys are made; nor does he clearly trace out the passage of the electric fluid, when the circuit is completed by depressing a key. To quote his own words—after explaining that, by pressing down a key, the pawl is caused to release the ratchet-wheel, and the cylinder is thereby permitted to rotate until its stop comes in contact with the catch of the depressed key—he says “another key, which is afterwards lowered, producing a similar effect, allows the axis *a*, to turn an angle proportioned to the length of the arc of the helix between the two keys which successively stop the motion; so that if the cylinder *a*, is

provided with an electric interrupter, which opens and shuts the circuit every time one of the teeth of the ratchet-wheel passes through, the effect produced by this mechanism on an electric current will be identical to that produced by the rotation of a telegraph dial, provided with as many signals as there are keys in the apparatus, but with considerably greater advantage,—the rotation of the axis *a*, being uniform and regulated according to the greatest speed the receiving apparatus permits of without missing its effect. Communication being once established between the receiver and transmitter, it continues to subsist independently of the variation in the regularity of touching the keys, provided time be given for the hand to run over the divisions of the dial, which is performed in the shortest possible time, on account of the uniformity of the motion, which permits the apparatus being regulated to the greatest medium speed of the receiver; so that any person, indifferently chosen, provided he know how to read, is able to transmit intelligence without the apparatus making any mistake."

The clockwork that actuates the cylinder *a*, is wound up from time to time, as in ordinary cases; but the services of an attendant for this purpose may be dispensed with, by causing the bar *b*, in each descent, to act upon certain mechanism which will wind up the spring of the clockwork to such an extent as to more than compensate for the power expended at each movement in turning the cylinder *a*: when the spring is completely wound up, a small lever puts the winding-up mechanism out of action, to prevent over-winding.

The patentee claims, Firstly,—the application to telegraphic apparatus of a key-board, combined with a series of stops, disposed in the form of a helix around a cylindrical axis, so as to permit that axis to turn of a proportionate amount to the position of the key which is acted upon, as above described. Secondly,—the application to telegraphic apparatus of a parallel bar underneath the key-board, for enabling, indiscriminately, each of the keys to put in motion the axis of the telegraph.—[*Inrolled November, 1851.*]

To RICHARD EDWARD HODGES, of Southampton-row, in the county of Middlesex, Gent., and WILLIAM BROCKEDON, of Devonshire-street, in the same county, Gent., for improvements in surgical instruments.—[Scaled 24th June, 1851.]

THIS invention relates, firstly, to improvements in surgical instruments, to be introduced into passages or orifices in cases

where it is desired that parts of the instruments may expand when within the passages or orifices; and, secondly, improvements in surgical instruments for relieving the bowels, urinary organs, and other passages.

In Plate IV., figs. 1, and 2, exhibit an instrument suitable to be introduced into a passage or orifice in the human body; such, for instance, as where there is a stricture. It consists of a slender metal rod *a*, having, at one end, a handle *b*, and at the other a small rounded point or bulb *c*, to which is attached one end of an India-rubber tube *d*; and the other end of such tube is fastened to a metal tube *e*, that encircles the rod *a*, and is capable of sliding thereon. In using this instrument for opening or extending a stricture in the urethra, the tube *e*, is first drawn towards the handle *b*, so as to extend the tube in length, and thereby lessen its diameter, as shewn at fig. 2;—a small chain *f*, attached to the handle, is then connected to a hook on the end of the tube *e*, so as to retain the India-rubber tube, in an extended state, until it is introduced into the urethra; and, when this has been effected, the chain is unfastened, and the India-rubber tube recoils to its original length, with a correspondent increase of diameter (see fig. 1.), which has the effect of expanding or opening the stricture. Figs. 3, and 4, represent a modification of this instrument, intended for horses or other animals. In this case, there are four India-rubber tubes *d*, secured at one end to the rounded point or bulb *c*, of the rod *a*, and at the other to separate rods *e*, which are substituted for the metal tube shewn at *e*, in figs. 1, and 2. Instead of a chain being used, as the means of retaining the India-rubber tubes in an extended state, the rod *a*, is furnished, near its handle, with four curved pins or hooks *f*, and in each of the rods *e*, a suitable eye is formed; so that as the rods are severally drawn back, in order to reduce the diameter of the instrument, the eye of each rod is passed over the corresponding hook, and is thereby secured. When the instrument has been introduced into the urethra, the rods *e*, are successively disengaged from the hooks, and the India-rubber tubes consequently contract in length and increase in diameter, as exhibited at fig. 3. The rod *a*, may be made hollow, so as to admit of the passage of liquid through it. The patentees remark, that this instrument may be varied in its details, so long as its peculiar character be retained, and India-rubber so used that it shall be of small diameter when introduced into a passage or orifice and expanded in diameter within the passage or orifice.

Another improvement consists in making plugs for gun-

shot wounds of a short piece of India-rubber, either solid or tubular, and having a string tied to each end. In using the plug, one of the strings is first passed through the wound; then, by pulling both strings, the India-rubber is extended in length and reduced in diameter, so as to admit of it being introduced into the wound without difficulty; and when it has been properly placed in the wound, the strings are released, and the India-rubber, by contracting in length and expanding in diameter, completely plugs up the wound.

The second part of the invention relates to the construction of instruments for assisting excretions by means of partially-exhausted receivers or vessels. Such vessels may be made of any material which can be fitted for the purpose; but the patentees prefer gutta-percha, because it is firm enough to resist the external pressure when subjected to the degree of exhaustion necessary for effecting the object of this part of the invention, and is capable of being moulded to the form required, so as to be air-tight and yet fit against the person without painful pressure. When a gutta-percha vessel, of a convenient form as a recipient, has been made, the edge of the mouth or aperture thereof is to be rendered soft and plastic by immersion in warm water, and then it is to be applied to the body of the patient and moulded to the required form, so that, when afterwards used in a cold state, it will fit air-tight to the body. A suitable air-pump or exhausting apparatus is to be connected with the vessel, for the purpose of exhausting the same when it is applied to the body of the patient, and thus inducing the discharge of the liquid matters from the body into the vessel; and a valve is also to be fitted to the vessel, in order to admit air into the same and destroy the vacuum, when it is desired to remove the vessel from the body.

The patentees propose to employ an instrument of similar construction to the preceding for obtaining milk from cows. A shield is made with apertures in it to receive the teats when it is pressed upwards in contact with the udder; it is connected in an air-tight manner with the vessel which is to receive the milk; and this vessel is sustained in a suitable position by bands or straps, fastened over the cow's loins. The vessel is exhausted of air to the desired extent by means of an air-pump or other apparatus; and when as much milk as is required has been obtained, a valve is opened to admit air and permit the vessel to be removed. The shield for the teats may form a part of the vessel, and act as a cover or air-tight top; or the milk-pail or vessel may be placed on the

ground or in any other convenient position, and connected by a pipe with the udder shield,—which latter, in this case, should terminate in an air-tight funnel connected with the milk-pail.

The patentees claim, as their invention, the construction of surgical instruments herein described.—[*Inrolled December, 1851.*]

To HERBERT MINTON, of Hart's Hill, in the county of Stafford, Gent., and AUGUSTUS JOHN HOFFSTAEDT, of Bridge-street, Blackfriars, in the City of London, Gent., for an invention of improvements in the manufacture of faces or dials for clocks, watches, barometers, gas-meters, and mariners' compasses, or other articles requiring such faces or dials,—being partly a communication.—[Sealed 17th March, 1851.]

THIS invention refers to the substitution for the wood, metal, and enamel faces or dials of clocks, watches, barometers, gas-meters, and other indicating instruments, of porcelain or earthenware faces or dials,—whereby a great saving in the manufacture will result; and, when desired, the facilities possessed by potters, for ornamenting their goods, may be applied to the decoration of such faces or dials. In carrying out this invention, the slabs or shapes, constituting the body of the graduated faces or dials, are first formed by pressing plastic clay, prepared in the ordinary manner, into moulds, or by throwing them on the wheel, and afterwards turning them down in the lathe; and they are then submitted to the drying and firing or baking process, in the same way as other articles of china or earthenware; which process must be regulated according to the quality or composition of the plastic material used. Or, instead of employing plastic clay, these slabs or shapes may be produced by the dry powder process, in the manner pursued by Messrs. Minton and Co., in making tiles, by pressure, from powdered clay or powdered minerals, according to Mr. Prosser's patent, dated June 17th, 1840.

The slabs or shapes having been obtained by either of the above-named processes, they are now to receive the graduations, figures, or patterns, which are to fit them for the several purposes above indicated. This may be done in several ways: firstly, by printing the graduations, figures, or patterns, on paper, in the same way as patterns for earthenware or china are printed, and transferring them to the bisque; which, after undergoing the well-known preparation process, prior

to the glazing operation, is then glazed, and passed through the glost oven; or the slabs or shapes are first glazed and passed through the glost oven, and then the graduations, figures, or patterns, appropriate to the article for which the slabs or shapes are intended, are applied to the glazed surface, either by painting by hand or by the printing process; and, when thus prepared, they are passed through the enamelling kiln, whereby a combination will be effected between the glaze and the colors used in finishing the slabs or faces.

In some cases the device for the slabs or shapes may be obtained and applied after the manner pursued by Messrs. Minton and Co., under the surface-printing process, for which letters patent were granted to Messrs. Collins and Reynolds, dated 14th March, 1848.

Another mode of applying the devices to the slabs or shapes is by employing the process patented by Mr. Wright, on the 26th January, 1830, and used by Messrs. Minton and Co. in the manufacture of their encaustic tiles. By this process the ornamental or other characters or figures, forming the device, are pressed into the clay before the article is submitted to the process of baking or firing, and the indentations are filled up with a liquid clay or slip of one or more colors, as the case may require. The article thus treated is then submitted to the process of firing; after which it will present a beautiful appearance, even without being glazed; but, if thought desirable, it may be submitted to the process of glazing, which, in some instances, will greatly increase the beauty of the colors employed in decorating the article.

The patentees remark, that this new manufacture of faces or dials is applicable to a variety of instruments besides those enumerated; as, for instance, counting apparatus, electric telegraphic apparatus, thermometers, &c. They do not therefore limit the application of their invention to the articles above enumerated, but claim, First,—manufacturing faces or dials of plastic clay, or other analogous plastic material, having devices thereon, suitable for the purposes to which they are respectively to be applied. Secondly,—manufacturing the faces or dials of clocks, watches, barometers, and other articles requiring such faces or dials, from powdered clay or other analogous compound or substance, by pressure, and applying the requisite devices thereto by any of the well-known printing or painting processes. And, Lastly,—the application of the process now employed in the manufacture of encaustic tiles to the manufacture of faces or dials of clocks, watches, and other articles requiring the same.—[*Inrolled September, 1851.*]

To JOHN PETER BOOTH, of Cork, in the Kingdom of Ireland, feather purifier, for an improved manufacture of fabric, applicable to the construction of muffs, boas, tippetts, and other like articles; and also to the ornamenting of articles of dress and furniture, and other similar uses.—[Sealed 31st March, 1851.]

THIS invention consists in the manufacture of a new fabric, which may be used in the place of furs or skins, whether for trimming garments and curtains, or for making up into muffs, boas, tippetts, or other like articles. This improved manufacture, which may have any suitable textile fabric for its base, is produced by the application to such fabrics of parts of feathers, in such a manner as to effectually secure them to the fabric, without, in any material degree, destroying its flexibility. The feathers which are used, in preference, for this purpose, are those obtained from the turkey. In making a superior class of goods, the patentee strips from these feathers the down or fine filaments attached to the sides of the stem, bringing off therewith a portion of the cuticle of the stem or quill. Having obtained a suitable number of these strips, he then sews them on to the fabric which is to form the base of the manufactured article, by means of a needle and thread, passing the thread through the fabric and over or through the cuticle or horny substance to which the down is attached. These strips are arranged in lines at as nearly equal distances apart as is practicable,—the distance being determined, in part by the quality of the article desired to be made, and in part by the length of the downy filament; but, in every case, the strips are placed so near together that the down or filamentous parts of the several rows shall, as nearly as possible, hide the stitching, and present the appearance of a continuous fleece or a natural feathery surface.

The patentee remarks, that he is aware it has heretofore been proposed to employ feathers and down for the decoration of garments, and other purposes for which furs or skins are used; but, in the one instance, the feathers have been used with their stems or stumps, and have therefore formed a stiff covering, altogether unsuitable for ordinary service; and, in the other case, the down (which is, in fact, a soft bushy feather, having a minute tender stem), although capable of being applied to the manufacture of soft flexible articles without the removal of the stem, is, when stitched or otherwise attached to a textile fabric, very liable to injury and displacement, from the accidental exercise of the least friction;—

whereas, according to the present invention, a strong and durable fabric may be made, having the softness and beauty of articles made of down, without possessing the before-mentioned defect, which is common to such articles.

The patentee claims the application of parts or strips or strippings of feathers in the manner and for the purposes above set forth.—[Inrolled September, 1851.]

To JOHN ASHWORTH, of Bristol, manager of the Great Western Cotton Works, for certain improvements in the method of preventing and removing incrustation in steam-boilers and steam-generators.—[Sealed 29th May, 1851.]

THE improved method of preventing and removing incrustation, which constitutes this invention, is applicable to the boilers of stationary, locomotive, or marine steam-engines, and to all other steam-generators liable to internal incrustation. The improvement consists in the use of a compound for preventing the lime or any other substance which the water may contain in solution (when fresh water is employed), or the saline compound, such as sulphite of magnesia, chloride of sodium, &c. (in marine boilers), from forming an insoluble incrustation and adhering to the interior of the boiler, and for loosening and removing such incrustation when already formed.

The ingredients used in the preparation of the compound or mixture are coal-tar, linseed-water, plumbago or black-lead, and Castile soap. The compound is prepared by taking 33 gallons of coal-tar, 21 gallons of linseed-water (prepared by boiling in water 14 lbs. of linseed, and straining or removing the seeds and other extraneous matter), 5 lbs. of plumbago or black-lead, in a pulverized state, and 8 lbs. of Castile soap, and stirring the whole well together, so as to intimately combine the same, and produce a compound of a creamy consistence. Although these are the ingredients and proportions which are preferred, yet they are capable of slight modification: for instance, common soft or black soap may be substituted for the Castile soap; or the exact proportions may be slightly varied, without materially affecting the action of the compound. The mixture or compound is introduced into the water in the boiler (after blowing off the steam), through the man-hole or other suitable inlet, in the proportion of about one gallon, twice a week, for a thirty-horse power boiler;—the quantity being increased or diminished, according to the capacity of the boiler and the average amount

of incrustating material contained by the water used therein. It is stated, that the effect of this compound upon a new boiler is to prevent any serious amount of incrustation upon the interior of the boiler; as the little deposit which occurs is of a thin, brittle, porous, and crumbling nature, and may be readily removed from the bottom of the boiler (on to which it falls) by sweeping or otherwise. In old incrustated boilers, the action of the compound upon the incrustation will, in a short time, loosen and remove the same.

The patentee claims the application, employment, or use of a mixture or composition of coal-tar, linseed-water, plumbago or black-lead, and Castile or other soap, for the purpose of preventing or removing incrustation in steam-boilers and steam-generators, without confining himself to the exact proportions of the ingredients named, or the precise method of using the same, as above described.—[*Inrolled November, 1851.*]

To WILLIAM BIRKETT, of Bradford, in the county of York, agent, for improvements in obtaining soap from wash-waters.—[*Scaled 12th June, 1851.*]

THIS invention consists in obtaining soap from soap-suds or wash-waters by the following process:—The suds or wash-waters are first evaporated to a pasty or cream-like consistence; then common salt, or it might be other soluble salt, is added; while, at the same time, the pasty mass is kept boiling, until the fatty matters separate from the water and salt; when this takes place, the whole is allowed to settle for a short time; and then the fatty matters are skimmed off and put into another pan. Caustic soda or potash ley is added to the fatty matters, and they are reconverted into soap, either hard or soft, according to the alkali employed; or the fatty matters, obtained in this manner from suds or wash-waters, may be combined with other fatty matters or rosin, and converted into soap. The ley and refuse, resulting from the above process, are allowed to settle; and then the clear liquor is evaporated, so as again to be used, in place of the soluble salt before mentioned, for separating the residue from the water.

In conclusion, the patentee states that his invention consists in treating suds or wash-waters by evaporation, and separating the remainder of the water and refuse matters by a suitable soluble salt, and then employing alkali to convert such product again into soap.—[*Inrolled December, 1851.*]

Scientific Notices.**ON BREWING AND DISTILLING.***(Continued from page 40.)*

It will, perhaps, be remembered, that our previous observations on brewing concluded by a general outline of the process of mashing, with a few brief remarks respecting the chemical composition of beer-wort. We now resume this subject; but to render its comprehension more easy, as well as to give a practical turn to our labors, we deem it requisite to enter into a detailed account of operations actually performed, and to exhibit in full the various changes that ensue from the commencement to the completion of the brewer's art. First, however, let us explain, in the clearest and simplest language, what that fluid is which the brewer designates by the old Saxon term "wort," or herb, as it is rendered in English. We have previously stated, that the peculiar properties contained in wort, do not exist ready formed in malt, but are the result of the direct action of heat and water upon that substance. Hence it follows, that the composition of beer-wort depends more upon the process of mashing than upon the malt employed,—for it would be quite practicable to obtain from one part of malt and eight parts of barley, a wort precisely similar to that procured from nine parts of pure malt alone. But, of course, this could not be done without modifying, considerably, the process of mashing; and it happens, unfortunately, that the practice of the present day, amongst brewers, is to maintain, as closely as possible, one uniform system of mashing, whatever may be the nature or quality of the malt employed. Thus a difference in the malt is made to produce a difference in the wort; and all the energy and skill of the practical brewer are sometimes insufficient to compensate for the alterations which this difference induces in the subsequent working of the beer. With a regular and certain composition, as to the constituents of his wort, the operations of the brewer would assume a fixed and definite character, which, at present, they are very far indeed from possessing; and by which he not unfrequently suffers the most severe pecuniary loss and mental anxiety. With the exception of a trifling quantity of vegetable albumen, the only solid ingredients of beer-wort are dextrine and sugar; the latter of which ferments with great ease and rapidity, whilst the dextrine, though capable of fermentation, enters into the

process only with difficulty, and requires, for its successful termination, not only much more yeast but also a much higher temperature in the fermenting vat. At the same time it is this very sluggishness in the fermentative quality of dextrine which is essential to the production of good beer; for, with sugar alone, the fermentation cannot be checked at ordinary temperatures, until the full measure of its decomposition has taken place, and it has become either a vapid admixture of alcohol and water, or, by the absorption of oxygen, is resolved into vinegar. It is indeed a notorious fact that beer, made with sugar, will not keep so well as that made from malt; though, for rapid consumption, the use of sugar is, under some circumstances, to be commended, more especially on the small scale and in cold weather. The peculiarity of dextrine is, however, as we have stated, to undergo fermentation only with difficulty and by slow degrees; hence, its decomposition spreads over a long space of time, and, in very cold weather, amounts to nothing; so that, for months or even years, after all the sugar of the wort has been destroyed, the evolution of carbonic acid gas from the still fermenting dextrine, keeps up a briskness and vitality in the beer; and, by excluding oxygen, all chance of acidification is shut off. A perfect beer-wort should therefore have reference to the period of its consumption; if this be speedy and pressing, the proportion of sugar ought to be large; if remote, the dextrine should greatly predominate. Under the first condition, the attenuation would proceed quickly, and, provided the temperature of the fermenting vat was not allowed to exceed 78° , the beer would soon cleanse and become ripe and bright: under the second, the attenuation in the vat would be slow and trifling, and require, perhaps, several years for its completion in the cask. Nevertheless, if the attenuation in the vat had gone on to the complete destruction of all the sugar, this kind of beer would prove, in the end, both the better and more healthy beverage of the two; for, by the mode of its formation, the presence of ænanthic ether, or fusil oil, is avoided. The importance therefore of placing in the hands of the brewer a means of determining the relative amounts of sugar and dextrine in his wort is sufficiently obvious. Now, this may be done in two ways, either by ascertaining in wort, of a determinate strength, the proportion of the one or the other of these substances. The dextrine is easier of calculation than the sugar, in a rough or approximative way, but the sugar can be determined with much more minute accuracy than the dextrine. Yet, in practice, the former plan is preferable, from its simplicity, as we

shall proceed to shew. If, to a certain volume of strong wort (say 30 lbs. per barrel), we add an equal amount of alcohol or spirit of wine, the whole of the dextrine will precipitate as a dense coagulum; and, by examining the bulk of this deposit in the tube, its weight may be inferred pretty nearly, if the tube has been previously graduated, so as to indicate, from actual experiment, the weight of the different measures of the coagulated dextrine. With weaker wort, more alcohol must be used, and with a denser wort less alcohol,—the relations of which to each other may easily be kept recorded on a small card or scale affixed to the tube. This instrument is very easy of application, and has been found extremely useful by more than one practical brewer of the present day; and the accompanying record of brewing operations has reference to this mode of analyzing wort. The determination of sugar in wort is best effected by boiling 100 grs. of it with about half a pint of the following solution, and collecting and weighing the red-colored precipitate which ensues,—every three grains of which indicate one grain of grape sugar in the wort.

Grape sugar test solution.

Sulphate of copper, in crystals	100 grs.
Bitartrate of potash	200 grs.
Carbonate of soda, in crystals	800 grs.
Boiling water, one pint, or	8750 grs.

First dissolve the sulphate of copper, then the bitartrate of potash; after which add the carbonate of soda, and filter if necessary. This solution is not affected when boiled with cane-sugar, dextrine, gum, or starch.

We now proceed to lay before our readers the result of two brewings, taken from one mash at two different periods and analyzed, to determine their relative contents of dextrine and sugar, according to the tube or alcohol process:—March 28th, 1851, proceeded to mash for experimental brewings; weather clear and open; thermometer outside 51°,—in fermenting room 58°; difference between wet and dry bulb 5·75°; barometer 39·4 inches. Composition of the malt:—Moisture 6·1; insoluble matter 27; extract 66·9. Quantity of malt employed 70 bushels; of water, at 180° Fahr., 700 gallons; made the mixture with a common mashing-oar, and finished in 15 minutes. One hour afterwards, drew off 200 gallons of wort; and, three hours from commencing to mash, drew off 200 gallons more,—continuing the mash for table-beer-wort. The first-drawn wort contained 7·5 parts of dextrine to one of sugar; the second, 6·3 parts of dextrine to 2·2 of sugar;—their densities were, respectively, 30 and 36·5 lbs.

per barrel. They were each boiled separately, with relative amounts of hop,—the first having 30 and the second 36½ lbs. added; and the boiling in each case was kept up for three hours. At the end of this time, both were cooled and diluted with water to a gravity of 27½ lbs. per barrel, and 250 gallons of each let down into separate fermenting-vats, placed side by side; after which, they both received three quarts of good yeast,—the temperature being at 68° Fahr. Two hours afterwards, the following observations commenced,—No. 1 being the wort containing 7·5 parts of dextrine to 1 of sugar, and No. 2 the wort having 6·3 of dextrine to 2·2 of sugar:—

		No. 1.		No. 2.	
		Temp.		Temp.	
1851.					
March	28.	5 P.M.	No action 67·5	No action	68
"	"	10 P.M.	Light thin cream . 67·5	Fine white head.....	70
"	29.	9 A.M.	White head 70	Thick yellow head.....	74
"	"	6 P.M.	Fine white head... 71	Fine tough brown head	77
"	30.	9 A.M.	Thick tough head 74	High rocky head	77
"	"	6 P.M.	Tough brown head 75	In rapid fermentation .	76·5
"	31.	2 P.M.	Roused up. Ferments well ... 75	Throws up much yeast	76
		Deg.		Deg.	
		Attenuation of No. 1 8½		Ditto of No. 2.....	
April	2.	2 P.M.	10	"	15·5
		Skimmed off yeast.			
"	11.	2 P.M.	15	"	17·5
"	13.	2 P.M.	15·5	"	18·2

The temperature of both had now fallen to 69° Fahr., though each had been roused repeatedly; the yeast was, therefore, again skimmed off, and the beer run into barrels, and filled up with reserved wort three times a day, as it worked over. On April the 18th, the barrels were closed, having then lost, by attenuation,—No. 1, 16·2 lbs., and No. 2, 19·6 lbs. Six weeks afterwards these ales were examined;—No. 1 was found muddy and unpleasant; whilst No. 2 had a fine fragrant aroma, a brisk lively appearance, and was perfectly bright. On January 2nd, 1852, the casks were again examined;—No. 1 had now lost 17·9 lbs., and was bright, rich, and fine flavored; whilst No. 2, though bright and pleasant, had contracted a little acidity, and was becoming flat: it had lost, in all, 21½ lbs.

Two similar experiments, made about the same time in another quarter, gave almost exactly the same results; and, consequently, there can be little doubt that, where a quick sale and rapid consumption of beer can be ensured, the great object of the brewer should be, to convert as much of the dextrine of his wort into sugar as is proportional to the rapidity of that consumption; whereas, for beer intended to keep, the opposite practice should be followed.

The conversion of any given amount of the dextrine wort into sugar may be effected, either by keeping up the temperature of the mash-tun, and prolonging the operation of mashing; or, which is better and simpler, by merely preserving the wort for a few hours at a heat of 170° Fahr., either in the under-back or any other convenient vessel. We have found, from experiment, that a wort which, when run out from the mash-tun, had only 3 parts of sugar to 16 of dextrine, became, by 10 hours exposure to a heat of 165° , converted almost altogether into sugar,—the proportions then being 17.8 of sugar to 1.2 of dextrine.

A very important part of the duty of a brewer should, therefore, be—first, the determination of the relative amounts of dextrine and sugar required to suit the taste of his customers, or the circumstances of the market,—and next, the continued careful examination of his worts, so as to insure that these proportions are regularly maintained: for by no other plan is it possible to insure that certainty of result, and uniformity of quality, which are essential to the proper conducting of an expensive business like brewing. It seems to us that far too little attention has hitherto been given to the fluctuating qualities of beer-wort. In warm weather, this wort should probably contain at least twice as much dextrine as in winter; yet this is the very period when, from the increased temperature of the air and materials, the largest quantity of sugar must be formed by those who mash upon a fixed and unvarying principle. Hence, the proneness of the wort to ferment violently in summer, is still further increased by the presence of an extra proportion of sugar;—whereas, prudence would suggest, under such circumstances, a predominance of dextrine, and seek to effect this purpose by a low temperature in the mash-tun, and by shortening the period of mashing. We are not, however, aware that this custom prevails, except in one or two solitary instances in the north of England, where it is well appreciated. As a general rule, in the management of worts, more sugar is requisite where small quantities are brewed at a time, than where large operations are conducted: for the loss of heat is relatively larger in small masses than in large ones; and, from what has been stated, it must be apparent, that as the fermentation of dextrine is more easily checked by cold than that of sugar, the beer brewed in trifling quantities could not preserve a fermentative temperature, but would become chilled and dead from the excessive radiation of caloric, unless a principle existed in it capable of fermentation at the most ordinary temperatures of this country. If, therefore, beer-wort consisting

chiefly of dextrine, be fermented in very cold weather, or with an insufficiency of yeast, or if the temperature happen to rise too high, so as to destroy or impair the fermentative power of the yeast, then a dull languid action will ensue, accompanied by what has been called the viscous fermentation, and the beer becomes permanently ropy, and is spoiled.

Although, clearly, it would be impossible to lay down any specific rule for the proper proportion of dextrine and sugar in beer-wort, yet there could be no difficulty in each brewer determining for himself; and for the conditions of size, time of sale, time of year, and other contingencies, the requisite ratio to be established in his own case; and, as we have shewn, nothing can be simpler than the means proposed for ascertaining the composition of wort.

The advance of the arts is gradually assuming a character which will no longer permit any manufacturer to neglect the assistance of science; and those who first take advantage of the power of knowledge, will assuredly leave their fellow-laborers behind. From being an uncertain and hazardous operation, brewing must, ere long, become a fixed and definite principle, based upon facts well understood, and capable of perpetual repetition and reproduction at will. To sum up briefly the general details of ale brewing, we may state, that for most kinds of ale, the attenuation, in the first instance, should be finished in from 6 to 21 days, according to the strength of the wort; that this attenuation should approach to two-thirds of the whole weight; and that, after tunning and cleansing, the ale itself should weigh about one-fourth of the original gravity of the wort. Thus, if the fermenting tun be set with wort of 27 lbs., then the attenuation should bring it down to 9 or 10 lbs., and the subsequent operations produce an ale weighing from 6 to 7 lbs. When these conditions are fulfilled, without much extra trouble or attention, the ale is pretty certain to turn out well; though, in some localities, ale is never attenuated to more than one-half its original gravity: this kind of ale is, however, very apt to become sour in hot weather and ropy in cold.

We will now proceed to describe the brewing of porter, which differs from that of ale both in the nature of the materials used, and in the mode of finishing the fermentation. Porter owes its peculiar color and flavor to burnt saccharine or starchy matter; and this was formerly obtained by burning sugar until it exhaled the odour called by French writers "*caramel*." At present, however, nothing but highly-torrefied malt is used; and of this there are several kinds,

as brown malt, imperial malt, and black malt,—all of which are used by some brewers, whilst others employ only the brown and black, and a few the black alone, for giving color and flavor. The fermentative quality or saccharine, is, however, the same as that of ale; and is derived from pale or amber malt. As a general rule, the ratio of the coloring and flavoring malts are, to the saccharine, as about 1 to 5, or 1 to 4; but where black malt only is used, the proportion does not exceed 1 to 10.

The employment of these burnt malts leads to a singular act of injustice on the part of the Excise, as regards the drawback on exportation. By the Excise regulations, it is assumed that a quarter of malt will produce four barrels of ale, brewed from wort of the sp. gr. 1·054, or 19·4 lbs. per barrel; but, although this is hopeless, even with pale malt, yet with an admixture of brown and black malt, the assumption becomes absurd in the extreme. Admitting that, by good management, on the average, four barrels of wort, weighing 20 lbs., can be obtained from one quarter of fine pale malt, yet in the operations of cooling, fermenting, tunning, skimming, and cleansing, a loss of fully 10 per cent. occurs under the most vigilant superintendence; and—taking the great bulk of our metropolitan breweries—it would be nearer the truth to estimate this loss at 12 per cent. In plain words, 100 gallons of wort will not, by any management, produce more than about 88 gallons of saleable beer, though no allowance is made for this by the Excise; and the brewer, who has paid duty upon 100 gallons, gets a drawback upon but 88. This, however, is the most favorable view of the case; and we solicit attention to the force with which the argument returns in the instance of porter.

If a quarter of pale malt be assumed at 84 lbs. of saccharine strength, then such an admixture of brown and black malt as is usually employed by brewers of porter, will not give more than about 24 lbs.; and as this constitutes at least one-fifth of the whole bulk used in porter brewing, we see that a quarter of such mixed malt can never give more than 70 lbs.: that is to say, 80 parts of pale malt, mixed with 20 of brown and black, instead of giving at the rate of 84 lbs.,—as pale malt alone does—would give but 70 lbs., or produce a difference between the actual return and that taken for granted by the Excise authorities, of no less than 16·6 per cent; to which, if we add the loss previously mentioned as arising from fermentation, yeast, &c.,—and which we have called 12 per cent., a total difference ensues of 28·6 per cent. between the

duty paid by the brewer and the drawback allowed by Act of Parliament. But the grievance does not stop here, for the only return allowed by Act of Parliament, is based upon the malt duty, and nothing whatever is said of the duty on hops. This, however, is at the rate of 19*s.* 7*d.* per cwt.; and since hops yield only about 35 per cent. of their weight of soluble matter, it would require 168 lbs. of hops to produce a barrel of fluid or wort weighing 19·4 lbs., or having the requisite Parliamentary specific gravity of 1·054. Upon this barrel, when exported, the drawback is 5*s.*; but, as may easily be seen, on calculation, the duty paid by the brewer has been 29*s.* 3*d.* In fact, upon every 168 lbs. of hops consumed by the export brewer, he suffers a dead loss of 24*s.* 8*d.*,—independently of the waste incidental to his various processes. These things may seem startling, yet we challenge the entire Board of Excise to prove that they are anything other than under-estimated. At the same time, the intelligent reader will gather, that the profits of brewing are not by any means so large as a cursory glance at the subject might warrant: and we say this rather as having reference to schemes now in progress for reducing the price of beer, than from its connection with our general arrangements. No doubt the brewing business has been of late singularly prosperous; and if the price of malt continues as low this year as it was last, the public have a right to look for some reduction in the price of ale and porter; but it must not be forgotten that the capital required is large, and invested in very perishable materials, such as casks and other wooden utensils, the wear and tear upon which is a very large item; nor again, as we have shewn, must a speculator begin by assuming, with the Excise authorities, that a quarter of malt will produce four barrels of beer,—for he will be much nearer the truth if he estimates his saleable produce at three barrels. As, however, it forms no part of our present task to enter into the financial statistics of brewing, we return to the object more immediately in view, merely throwing out, "*en passant*," the above hints for the benefit of those whom they may concern.

If the analysis of malt and malt-wort are requisite, to enable a brewer to perform his operations with safety and success, the analysis of beer is not less indispensable, to qualify him for the harassing labor of competition with his neighbours; and for the protection of his interest against Excise confiscation. Although beer may have been brewed of the requisite gravity for justifying a drawback on exportation, yet this is very far indeed from ensuring a return of the malt duty, even

to the limited extent awarded by law. The question is, how are the Excise officials to know the real weight of the wort from which the beer was brewed? This may be obtained by the following method, which should take the place of the present indefinite system:—Having agitated a portion of the ale or beer, so as to dissipate its carbonic acid-gas, measure out exactly 3,600 grain-measures of it, and pour these into a retort; then distil, with great care, into a receiver, surrounded by ice-cold water, about one-third of the whole fluid, or rather more than this if the ale or beer is known to be highly alcoholic. Next weigh the distilled fluid, and then ascertain its specific gravity; from whence, by any of the proper tables of alcoholic strength, the total quantity of absolute alcohol in the distilled fluid may be known. This alcohol is to be converted, by calculation, into its equivalent of sugar, at the rate of 171 parts of sugar for every 92 of alcohol found; after which, this sugar must be brought into pounds per barrel, by the rule given in our previous number, which is $52\frac{1}{2}$ lbs. of sugar for every 20 lbs. of gravity. The amount of vinegar is next to be determined, by any of the known forms of alkalimetry,—such as the use of carbonate of potash or soda, or caustic ammonia, in the way proposed and practised by Dr. Ure. This vinegar or acetic acid must, like the alcohol, be also converted into its representative of sugar, by assigning 171 of sugar to every 102 of anhydrous acetic acid present in the beer,—this sugar being, as before, converted into pounds per barrel. To the beer remaining in the retort, sufficient distilled water is then to be added, that the entire bulk of fluid may once more be equal to 3,600 grain-measures; and the temperature of the mixture, having fallen to 60° Fahr., its specific gravity must be determined in the usual way, and this reduced to pounds per barrel, by multiplying the excess above 1,000 by 360, and dividing the product by 1,000. The whole of these weights, added together, give the original weight of the wort. Thus, for example, we will suppose that 3,600 grs. of a particular beer have given 1,300 grs. of a dilute alcohol, of specific gravity .9731, and, consequently, containing about $17\frac{1}{2}$ per cent., by weight, of alcohol; again, that the same quantity of beer, when tested by carbonate of soda, has indicated 30 grs. of acetic acid; and, lastly, that the spent mash, when filled up with distilled water to its primary bulk, has, at 60° , a specific gravity of 1.016;—then the total alcohol would be, in 360 grs., or the representative of a barrel, $22\frac{1}{2}$ grs.; and the acetic acid in the same quantity, 3 grs.: hence we have the following results:—

	Gra. of sugar.	Brewers' lbs.
Alcohol, 22 $\frac{1}{2}$ grs., equal to	42.2 or	16.
Acetic acid, 3 grs., equal to	5. „	1.9
Spent mash, of sp. gr. 1.016, equal to		5.76
Total weight		23.66

It might be thought, that the proper kind of sugar to select, in this instance, as the representative of alcohol and acetic acid, should be the grape-sugar, whose atomic weight is 180; but it has long ago been shewn by Dr. Ure, that the kind of sugar actually employed in the construction of our saccharometer tables must have been cane-sugar, the atom of which is 171; and hence the reason why it must be employed in this calculation.

We now turn our attention to the business of the distiller, which is a kind of supplementary operation to that of the brewer. There are, however, some important differences, both in mashing and fermenting, between these two methods of producing alcohol; for the principal object of the brewer is to secure flavor and transparency to the fermented product; whilst the sole care of the distiller is to ensure the complete alcoholisation of all the saccharine and gummy constituents of his wort. We have seen that, to the brewer, the presence of dextrine was essential; whereas, in distillation, the more purely saccharine the wort, the better. On this account, although malt is much dearer than raw grain, many eminent distillers continue to employ it alone, from the simple circumstance, that its relatively large content of diastase furnishes, in the limited period assigned for mashing, an infinitely more saccharine wort than can be produced in the same space of time from a mixture of one part of malt and seven or eight of barley-meal. Nevertheless, by maintaining the wort from the latter at a sufficient temperature for a few hours, as indicated with respect to beer-wort, the diastase in it would exert its specific action upon the dextrine, and, in the end, give as saccharine a wort from mixed grain as from pure malt. This subject is peculiarly worthy of the attention of distillers; for the sluggish fermentative qualities of dextrine are such, that, very frequently, a considerable quantity of this substance remains in the wash unacted on, and passes away with the residue as a waste product. It is, indeed, customary for the distiller to seek a remedy for this, in the employment of large and frequently-repeated additions of yeast; and there can be no doubt of the propriety of this measure. Still, however, the true solution of this difficulty must be referred to a period

anterior to fermentation; and it is in the under-back where it should be grappled with and vanquished.

If we examine with care the catalytic effect of diastase upon starch, we shall find that the time employed by the distiller is far too short to achieve the object which it is his interest to bring about. In the case of the brewer, many conditions, as we have pointed out, require to be foreseen and provided for; and hence a uniform system of mashing is to be condemned in brewing; but the distiller has only one single circumstance to bear in mind, and that is, if possible, the total conversion of all the hordeine, starch, dextrine, and other constituents of his grain and wort, into sugar. In fact, he can scarcely, by any chance, mash too long, or keep his wort at 170° for too many hours;—at all events, the following observations demonstrate, that the time now employed is barely one-fourth of that necessary for success, under the most favorable circumstances:—A mixture, composed of one part of very fine malt and seven parts of barley-meal, was mashed with great care in a vessel capable of having its temperature kept at any required degree for many consecutive hours. The heat of the water was 180° ; and it was found, after thorough mixing, that this had fallen to 168° ; at which point it was accordingly decided to maintain it; and a series of experimental essays were made upon samples of the wort, with the view of illustrating the progressive formation of sugar. The results were as follows:—

		Sugar.	Dextrine.
2 hours after mashing		1·8	18·7
3 ditto	ditto	4·1	15·9
4 ditto	ditto	6·3	13·7
5 ditto	ditto	8·	12·
6 ditto	ditto	9·2	10·3
7 ditto	ditto	10·7	9·3
8 ditto	ditto	12·	8·
9 ditto	ditto	13·3	6·7
10 ditto	ditto	14·5	5·5
11 ditto	ditto	15·7	4·3
12 ditto	ditto	16·9	3·1

Hence, instead of three hours, which is the period commonly used for mashing, the distiller would be warranted in continuing this operation for twelve hours. In reality, however, it is only the wort which requires this treatment; for, after the third hour, all the starch, and nearly the whole of the hordeine, have become soluble, and nothing but continued heat is required to complete the saccharification of the wort. The working of the mash-tun need not therefore be varied, as it will suffice to maintain the under-back for six or eight hours, at a temperature of 170° . The advantage of convert-

ing all the dextrine into sugar is not limited to the mere saving of material, or the production of more alcohol, for there is another and most important object gained. Sugar ferments more freely and at a lower temperature than dextrine; consequently the heat of the fermenting-vat need never rise so high, nor require the large quantity of yeast now employed for the purpose of forcing a rapid and hot fermentation. Thus the tendency to generate fusil oil would be destroyed, as there is not the slightest doubt that the formation of this oil is due to an excess of temperature in the fermenting-vat, and constantly bears a relation to the amount of dextrine in the wort; for this, as we have before stated, necessitates the employment of a higher fermenting heat than sugar, by which the elements of the decomposing materials take on new and unusual arrangements. The presence of fusil oil in spirit is a serious impediment to the distiller, and either retards the sale of his produce or diminishes its value in the market.

As usual, the Excise regulations interfere much with the progress of this as of every other manufacture under fiscal superintendence. Careful to prevent fraud, they cripple industry, and seek, as it were, to secure the honesty of the laborer, by cutting off his hands,—ignorant or careless, meanwhile, of the permanent mischief which they inflict. Yet, we know of no more fitting subject for fiscal burdens than the manufacture of ardent spirits; and had Excise interference been limited to this branch of industry, we should have deemed it a matter for congratulation rather than otherwise. Nevertheless, consistency is a kind of virtue in politics; and we cannot imagine why the *quasi* superior moral and intellectual status of Ireland is continually tempted to err by a low duty of but 2*s.* 8*d.* per gallon, whilst nearly three times this amount is needed to repress the bad habits of the people of England. The duty now charged is, for England, 7*s.* 10*d.*, for Scotland 8*s.* 8*d.*, and for Ireland 2*s.* 8*d.* per gallon of proof spirit; but on what principle this graduated scale of temptation to drunkenness has been so fixed we are quite unable to conceive. To return, however, to the question of distillation, the duty may be charged the distiller in any one of three ways; viz., according to the gravity of the wort he uses, the attenuation of that wort by fermentation, or, lastly, the actual quantity of spirit which he produces,—the latter being, of course, the only just mode of charge. The restrictions and penalties are excessive, as our courts of law too frequently testify; and the notorious prevalence of smuggling seems to prove that the present rates of duty are too high,

and offer a premium for fraud greater than the terror of a temporary imprisonment. The greatest improvement in modern times, as regards distillation, is that brought about by the invention of the apparatus now well known under the name of "Coffey's still." It would be foreign to our task to give a minute description of this contrivance,—the principle of which is somewhat similar to that of the *cascade chimique* of Clement Desormes. The wort or other fluid to be distilled is made to flow over a very extensive surface in contact with a current of steam passing in an opposite direction; by which means the steam is condensed, and, giving up its latent heat to the more volatile spirit, this latter is driven on into the condenser in a state of great purity; whilst the residuary wort and the condensed steam flow out of the vessel from beneath in a continual stream. Mr. Coffey had many impediments to contend with, from the opposition of the Excise authorities, in his first attempts to introduce this ingenious invention into public use; but prejudice and ignorance have at length given way, and the Coffey's still may be now seen in operation at almost every large distillery in the kingdom. After the distiller has paid duty upon the spirit which he has manufactured, it is transmitted to the rectifier, whose premises must be a considerable distance from the distillery, according to Act of Parliament. The business of the rectifier is to purify the spirit by separating its fusil oil; and this he commonly effects through the agency of caustic potash. The impure spirit, being mixed with a portion of potash and carbonate of potash, is carefully distilled or rectified, until it ceases to possess any disagreeable odour, when it is again distilled in contact with certain aromatic substances, to give it the requisite qualities of the particular spirit or liqueur desired. There is, however, too much reason to fear that the necessary measures of purification are neglected in the case of common gin,—the defect being merely covered or concealed beneath more powerful odours. This practice cannot be too strongly reprobated; for experiments, made purposely on dogs, have convinced us, that fusil oil is a highly poisonous substance, and possesses acro-narcotic powers, of no ordinary energy. Its removal from an article of universal consumption, like spirit, ought therefore to be deemed an important subject for sanitary legislation, and not left to the casual skill or dubious honesty of any class of manufacturers whatever. There is more or less fusil oil in all the gin we have examined.

*Representation of the Case of the Executive Committee of the
Central Association of Employers of Operative Engineers.—*

Published by order of the Committee.

THERE is, perhaps, no stronger evidence of the necessity that exists for the better education of the industrial classes than the firmness with which they hold to the delusion, that, by a well-timed voluntary inactivity, they can improve their condition. Practically convinced as they have often been, of the utter fallacy of this belief, a fair occasion is seldom missed of again testing its truth; and we are now called upon to witness a repetition, on a great scale, of a contest, the result of which, supposing each party honestly to maintain their ground, may be unhesitatingly pronounced by any person who is but ordinarily well-informed in the simplest principles of our social economy. The cessation of labor, which has recently taken place, in an important branch of industry, by the principals of many of the large engineering establishments in the country having taken the initiative and closed their gates to their refractory workmen, is a fact to be greatly regretted, not merely because of the temporary misery which it cannot fail to inflict on many thousand persons who, for the most part, are innocent of all participation in the dispute, but because the sudden and causeless interception of labor may have the effect of permanently depressing this branch of industry. In saying thus much, we by no means intend to impugn the policy adopted by the employers; for if we may rely upon the plain unvarnished statement which they have put forth to the world, under the title which heads this article, no other course for rescuing themselves from a system of dictation, which was artfully planned, and has for a long time been carried out with success, seemed open to them. Now, we are very far from believing that the intention of the *Amalgamated Society of Operative Engineers* is to effect the ruin of their employers and erect themselves in their place; but we look upon the Society as a body of well-meaning men, who believe themselves entitled to certain privileges, and, fancying themselves possessed of power to enforce their rights, are resolved to employ it to that end. If then our judgment is correct, the Society is undoubtedly open to reason, and should, therefore, have had the whole bearings of the case laid before them by those who, at once, from their education and position, are enabled to see in it something more than two isolated and antagonistic interests striving for the mastery. It is, we think, by neg-

lecting all attempts to convince their workpeople of the impolicy of their proceedings, that the master engineers have failed in their duty,—they have felt greatly annoyed, and and doubtless with reason, at the petty persecution which they have for a long period had to endure; but in the printed statement of their case, now before us, they have confined themselves to a simple assertion of their rights, and the reasons which induce them to maintain them,—without attempting to demonstrate the effect which a voluntary and continued cessation of labor must have upon a flourishing trade, or what must ultimately take place in the relative positions of the master and his recusant workmen. This duty they have, apparently, left for the press; and, as it is a matter that comes more especially under our province, we shall, without binding ourselves to follow the subject through all its bearings, touch upon some of the more important points which it presents, with the view of ascertaining how far the position taken up by the operatives is consonant with a just estimate of the interests of that body. It will be unnecessary for our present purpose to enquire into the minutiae of the matters in dispute—as to whether or no the Council of the Society demanded the unconditional discharge of the unskilled laborers tending the self-acting machinery, or what kind of overtime was deemed pernicious, &c.—it will suffice us to assume, what all must admit, that some demands, whether reasonable or not, had been presented to the masters, leaving them no option between complying with those demands, or of being deserted by their workmen.

Let us now first ascertain the relative social position of the employer and the employed, in order to see whether they are really so entirely independent of each other as this statement of the case would seem to imply. On the one hand, is a party possessing ample pecuniary resources, and provided, by reason of a great outlay, with what we will term the *primary means* requisite to produce an important manufacture; on the other hand, is a party possessed of the *secondary means* necessary for completing the manufacture, viz., skilled labor,—but wholly dependent on this labor for support, and unable to bring it to account without the assistance of the primary means. The combination of the two produces, therefore, a result mutually beneficial;—but what is the effect of the severance of these interests? To the one party, work or no work is simply a question of profit and loss; to the other, it seems rather to be a matter of life and death. Under such unequal circum-

stances, it would appear but a foolhardy experiment voluntarily to relinquish a profitable engagement on any plea, in the absence of an immediate prospect of more remunerative or advantageous employment. But the announced determination of the principal employers to close their works on a given day precluded all hopes of this nature; and, therefore, the only ground on which the Amalgamated Society could depend for carrying their "points" is (forgetting the probability of their members being starved out in the meanwhile), the supposed *impossibility of the employers being enabled to resume operations without their assistance*. This belief we hold to be the leading error into which the operative engineers have fallen; and, as it seems common to the managers of Trades' Unions, an exposition of this error may not be without its use.

In the first place, then, it should be remembered, that the effect of a "strike" is to render the plant of the employer, during the suspension of labor, profitless, and, consequently, as far as the holder thereof is concerned, utterly worthless for the time being. He is, therefore, fairly justified, as a prudent man, in throwing out of calculation the important item of interest on invested capital, while considering how far his expected returns, on the re-opening of his works, will justify him in offering a bonus sufficient to induce workmen, engaged in kindred trades in his own locality, or in the same trade in distant places, to enter his service; and, by that means, he gives himself greater latitude in settling the rate of wages, without losing more than the interest of the capital expended on his plant, which has been rendered profitless by the strike. Thus, for example:—Suppose the proprietor of an extensive plant satisfied, in ordinary times, to carry on business at a yearly profit of 21 per cent. on his outgoings for labor, and that, of this sum, one-third, or seven per cent. on the outlay for wages, represents a fair equivalent for the use of the plant (which, from this small allowance, we assume is not liable to speedy deterioration), it is obvious that the employer, desirous of keeping open his works, has, during the continuance of a strike, a latitude one-third greater, within which he may prudently fix the wages of his workmen, than when business is proceeding in the ordinary way. Here, then, is a means of obtaining fresh hands thrust, as it were, upon the master—the lesser of two evils, inasmuch as it is far more advantageous for him to sacrifice the interest of his sunk capital, than to lose that and his manufacturing profits also. But what effect does this have

upon the disaffected workmen? Simply this, viz., that their places are, in great part, filled by men heretofore foreign to the trade: the average wages, therefore, paid to artisans in the branch of industry in question, must, ultimately, take a lower level. This is the mildest phase of the case, as against the Amalgamated Society; for, if the employers, for the attainment of a special end, are ready to go as far as their operatives, and temporarily sacrifice *all* their profits, they may hold out still further inducements to unfettered workmen; and they can surely then, even if they fail under the other supposition, find hands in plenty to lend their aid and baffle the designs of their opponents. France, Belgium, and Germany, have already furnished the means of putting down the real or fancied oppression of Trades' Unions; and why may they not affect the Amalgamated Society? for the engines and tools of foreign manufacture contributed to the Great Exhibition presented no little evidence of manipulative skill.

This is not, however, the only resource available to the employers of operative engineers; for experience has taught us, that it is not wise to set bounds to the powers of mechanism. If there be truth in the oft-repeated proverb, that "necessity is the mother of invention," it is on just such an occasion as the present, that we may expect the announcement of some new and ingenious arrangement of machinery, capable of achieving, in a superior and more economic manner, what has hitherto been effected solely by skilled labor. We have the evidence of Mr. Wm. Fairbairn, of Manchester, that the introduction of his rivetting machine, which is now in general use throughout the country, was entirely due to a strike of his boiler-makers; for, when examined last year before a Committee of the House of Lords on the Patent Bill, then under consideration, he is reported to have said, in speaking of this machine, "I had no reference to the public in doing this: I wished to relieve myself from what I considered an act of great injustice; and the object I had in view at the time was *to be independent of Unions and combinations.*" It would be easy to adduce many more cases to the same effect, shewing that the steps taken by workmen to coerce their employers, have actually tended to weaken their own legitimate influence, and have, in many instances, left them at the mercy of those whom they designed to reduce to submission. To those who have watched the wonderful advances made by Great Britain within the last half century, in almost every branch of her manufactures, this indisputable fact cannot fail to have presented itself as the natural result

of the progress of invention, viz., that, while the introduction of mechanical improvements tends to ameliorate the physical condition of the workman, it also increases the moral power of the employer. Unless, therefore, Trades' Unions can put a stop to improvement, we see no help for the gradual extinction of these societies, and the emancipation of masters from their thralldom. Our experience, however, of workmen, does not warrant us in supposing that they look so far ahead as to anticipate evils not yet apparent to their physical senses; they will not, therefore, even attempt to crush the inventive faculties of their own body; and, consequently, the world will continue to receive such aid from the practical knowledge of some of the most intelligent among them, as will, in time, effectually prevent the recurrence of strikes, from the evident hopelessness of any further attempt to reduce the employers to submission. This advance in mechanical science will not, in all probability, take place simultaneously in many branches of the operative engineers' trade, however desirable such aid may be just now; but which branch is the first destined to be remodelled it is impossible to say. If we were asked to choose an occupation more unlikely than another to be revolutionized by the introduction of machinery, we might, perhaps—judging only from the nature of the work—name that of “moulding and casting in metal,” as it requires great manipulative skill, and sometimes demands the exercise of no ordinary amount of ingenuity. We should, nevertheless, be wrong in assigning to the moulder a monopoly of his trade; for mechanism is already busy in casting pipes by the application of centrifugal force, and mechanical means have also been devised for preparing sand-moulds, to receive the molten metal. In fact, past experience tends to shew, that the only limit to the use of mechanism in the industrial arts is, when the exercise of the mind, and not mere skilful manipulation, is in constant requisition to direct the hand of the operator. If, then, the moulders should make common cause with the Amalgamated Society (as it is very probable they will), an excellent opportunity will be presented for the introduction of a system of mechanical moulding, the details of which are now before us, and give evidence of the practicability of the invention.

But, to return to the matter more immediately under our consideration, we have still to notice an important point, which the operative engineers have overlooked while disputing with their employers. To state the point concisely, it is simply this:—The demand for machinery, unlike that for

the necessities of life, as food and clothing, depends far more upon the means at the disposal of the mechanist for anticipating the wants of his customers than on the necessities of the customers themselves. To illustrate our meaning, we will suppose the following example:—The cost of steam-engines has hitherto excluded them from hundreds of small workshops, and compelled the use of hand-lathes, hand-drills, and hand-punches, whereby great labour has been entailed on the workmen, and frequent and unavoidable delays have been caused in their operations. We will now assume that the construction of the engine and boiler has been so simplified, and otherwise improved, that the cost of setting up this motive-power machinery is reduced one half, and an economy of 20 per cent. is effected in the generation and use of the steam: the immediate result of this is an increased demand for steam-engines from quarters whence no order would, under prior existing circumstances, have arisen; and what might naturally be expected to follow would be orders for more efficient tools, now that the means are at hand to work them. The trade is thus doubly benefited; firstly, by the manufacture of the steam-engines; and secondly, by the tools they are enabled to set in motion; and thus it must ever be on the introduction of improvements where capital is not wholly wanting. Now, let us see the reverse of this picture. The attention of a manufacturer is drawn to what is called an improvement in the throttle-frame; he tries it, and satisfying himself that it is such, determines that the improvement shall be applied throughout his factory, and gives orders to that effect. The work is scarcely in hand before a strike of the operative engineers takes place, and the order cannot be executed. But the manufacturer contents himself with the reflection, that his throistles are as efficient as his neighbours; and therefore they will serve his turn, though he might have done better with the addition of the improvement. Here, then, is a new and promising source of employment for the mechanist, wantonly cut off in the bud; for, even assuming the improvement to be one of but ordinary importance, it would have found its way, after the fair introduction we have given it, into all the principal factories, and caused the distribution of a large sum among the mechanical engineers. This assumed case, which most of our readers will recognize as a type of a large class, shews us, not only the direct loss which a strike is calculated to inflict upon trade, but also that there is an elasticity about the demand for machinery somewhat akin to that for mere articles of fashion; and therefore, that, by

cramping the executive means of their employers, the operatives are, in fact, narrowing the limits of their field of labor. It is impossible to say to what extent this may not be carried; but, if the practice of one branch of our manufactures will help us to a correct inference of the capability of others to exist in a tolerable state of prosperity, without the introduction of new machinery, we should say that, in the absence of foreign competition, which gives a great spur to improvement, manufacturers might work on with their present mechanism to an indefinite period; for it is well known that, by dint of constant tinkering up, a large number of the knitting frames, now in use in Nottingham and the neighbourhood, contain scarcely a piece which belonged to their original construction,—having undergone like transmutations to the Irishman's knife, which, by reason of its peculiar merits, was found to deserve now a new blade, and anon a new handle. This practice has not yet been adopted in the Lancashire and Yorkshire districts; nor do we think it very likely to obtain countenance in those localities; but we notice it, to render more evident the truth of our statement, that, while, on the one hand, the demand for machinery may be created to an unlimited extent, so long as inducements are held out to manufacturers to purchase,—on the other hand, the withdrawal of these inducements, and the contraction of the means of supply, involves the deterioration of the trade, without creating that public inconvenience which is always calculated upon, by workmen on strike, to promote the success of their designs.

We have thus shewn that the policy of the Amalgamated Society is open to objection on two grounds: first, because it is based upon the assumption that the labor market (as far as mechanical engineers are concerned) is a monopoly under their control; whereas, it is capable of indefinite extension, by the introduction of new hands to the trade, and by the application of machinery to new divisions of industry: and secondly, because placing impediments in the way of production is a sure means of lessening the demand for machinery. It would seem to follow, then, that all combinations, calculated to interfere, in any way, with the labor market, must be detrimental to the workman. This is precisely our opinion; and, as such, we deprecate all combinations of this nature, whether consisting of employers or employed,—for their practical tendency is to create a species of class legislation, the injustice of which bears a relative proportion to the amount of intelligence possessed by the executive body. While, therefore,

we denounce Trades' Unions as most pernicious to the interests of the labouring classes, we cannot look with a friendly eye upon any combination of employers that is intended to have a permanent existence; on the contrary, we think that, if the Central Association of Engineers finally determine to give permanence to their body, they will find that they have taken a step likely still further to retard an amicable adjustment of differences between themselves and their workmen. The grounds on which they claim the sympathy of their fellow-citizens are thus given in their printed statement:—

“1. The undoubted and unrestricted right of every laboring man in this free kingdom to follow any honest calling in which employers may desire to engage him.

“2. The unquestionable prerogative of every employer to make what arrangements and engage what workmen he pleases, upon whatever terms they choose mutually to agree.”

If the employers take their stand upon this basis, they may be certain of success; but let them declare their Association permanent, and establish an inquisition such as that now contemplated by their Committee, and public succours will not long be wanting for feeding their reculant workmen in idleness, and thus inflicting a lasting injury on one of the most important branches of our national industry.

PATENT LAW REFORM.

WE have now the satisfaction of being able to announce, that, by the operation of the Act of last Session, intituled, “An Act to simplify the forms of appointments to certain offices, and the manner of passing grants under the great seal,” a reduction has been made in the cost of English patents to the extent of £18; and that the process by which these grants are obtained is rendered less tedious than heretofore, partly by the abolition of some useless forms, and partly by the Lord Privy Seal having appointed an additional seal day at his office; the seal being now affixed to documents two days in each week, instead of one, as formerly, which practice involved the necessity of having frequent recourse to the expensive luxury of “private seals and expedition.” In the case of patents applied for in the names of two or more parties, being joint inventors, the reduction in the cost is somewhat greater, as it amounts to £23. 16s. on a two-named patent. It is supposed, and not without reason, that the fee charged at the Privy Seal (£4. 2s.) cannot be legally enforced;

and that, in consequence of a little gentle agitation of the matter, an order may be expected to issue from the Treasury for the abolition of this payment. For our own part, we are not very sanguine of the result, although we cordially concur in the movement.

INSTITUTION OF CIVIL ENGINEERS.

December 16th, 1851.

The paper read was, "*On the alluvial formations and the local changes of the south-eastern coast of England. First section, from the river Thames to Beachy Head,*"—by Mr. J. B. REDMAN, M. Inst. C.E.

The paper stated, that the passage of shingle along the English coast, due, as was generally believed, to the action of the waves alone, took, on the south coast, a course from west to east, and on the east coast, from north to south. During certain winds, the shingle was heaped up coincident with their direction; and repeated withdrawals and renewals (the latter being the most frequent), caused a leeward movement of the material,—forming it, at the same time, into a series of triangles, of which the shore was the base. If any natural or artificial projection intercepted this motion, an accumulation, which would increase or be held in check according to the state of the wind, took place up to a certain point, or until the angle formed was filled up, when the shingle would pass round. With groynes, by far the most common action was (unless they were of great height, or short length), for the shingle, after accumulating on the weather side to the level of the top of the groyne, to pass over it, and then travel to leeward.

The degradation of the north shore of Kent, the local formation of shingle around the Isle of Thanet, by the wasting away of that chalky promontory, and the retention of large masses of alluvial matter in Pegwell Bay, were dwelt on. The main belt of shingle lying to the south of Deal, and extending from thence to Dover, with its early and present effects on the harbour at the latter place, were then described; also the early condition of Folkestone harbour; the large accumulation of shingle arrested to the westward of that haven, by the projection of a low-water pier, or groyne, at right angles to the harbour; and its effect upon the shore to the eastward, by retarding the progressive motion of the shingle in that direction. Further on, the curious formation at Dungeness Point, which it was reasonable to suppose did not at one time exist, as the parallel "fulls" of beach between Romney and Lydd, and extending from Winchelsea on the west to Hythe on the east, seem formerly to have constituted the sea coast. The rectangular "full," running from the banks on the west side of Lydd towards the point, might have been

created by an accumulation of shingle travelling from the westward, held in check by the outfall of the river Rother: the angle contained by this spit, and the coast to the westward becoming gradually filled up with shingle, a silty deposit would take place on the east side, consequent on the gradual loss of Romney harbour; and the length of the spit would be increased by the parallel ridges of shingle periodically added to and travelling round it. Numerous examples, extending over two centuries, shewed that the average annual increase was six yards, reaching, over certain periods, an average of eight yards per annum—the absolute increase since the time of Elizabeth being nearly one mile; and they proved conclusively, that the average progress seaward, producing a determinate aggregate elongation in a south-easterly direction, was much greater than had been generally assumed, though not regular; for the ness had even been stationary during certain periods.

The gradual decadence of the ancient ports of Hythe, Romney, and Lydd, to leeward of this point, was then alluded to; as also the diversion of the outfall of the river Rother to Rye, once an estuary of the sea, and then forming Romney Harbour; the great increase of shingle to the westward; the early and abortive attempts to form a harbour at Hastings; and the vast abrasion of the coast along Pevensey Bay, the harbour of which place had been lost by the elongation and extension of Langley Point. Between the origin of this point and that of Dungeness there was a remarkable similarity, both having originally had a tidal haven to the leeward, eventually choked up by the elongation of these spits across their outfalls; both had pools or meres, arising from the land-locked waters; and in both cases the modern “fulls” of shingle could be plainly distinguished from the more ancient by their forms and direction. The remarkable decrease of this point (about three-eighths of a mile) during the last century, appeared to arise principally from Old Brighton beach no longer affording the necessary supply of shingle.

The early condition and present state of Cuckmere and Newhaven harbours; the great degradation of the coast at Rottingdean; the sweeping away, during Elizabeth's reign, of the beach and town of Old Brighton, then standing on the site of the present chain-pier—the materials from which formed the spits to the eastward—were then described.

The author had personally inspected the whole of this coast, the different sections of which he promised to give in succession; and had also examined the earliest accessible maps, and the works of the best topographical writers, who were frequently referred to in elucidation of the subject, which was one of vast importance in marine engineering, especially in reference to the construction of harbours and coast-works of defence; as he submitted that it was most desirable that such natural agencies as had been described, and the many instances of the compensating effects of alternating loss and gain, should be correctly understood.

December 23rd, 1851.

The Annual General Meeting for the election of the President, Vice-Presidents, and other members of Council for the ensuing year—for receiving the Annual Report of the retiring Council—and distributing the medals and premiums, was held on this evening.

The report referred particularly to the late Great Exhibition; many of the competing designs for the building, as well as the suggestions for the guarantee fund, and several important points connected with the classification, &c., having emanated from members of the Institution; and amidst the Royal Commissioners, the Building Committee, their Executive Staff, and the Jurors, many were to be found. Even the designer of the present building, and those whose energies were so successfully devoted to the task of its construction, also belonged to the Institution; whilst “the weight of responsibility, the arduous duty of supervision, the honor of acting as the master mind to weigh the requisites, to determine the design, and to govern the construction,” were reserved for Sir William Cubitt, the President. The professional and scientific visitors from foreign lands received much assistance and information in their enquiries in this country; and it was confidently hoped, that the relations with other countries might become more intimate, and that collective and individual benefit would be promoted.

The principal papers which had been read were noticed, and their objects and merits explained in a few expressive sentences; though it was regretted that they were not so numerous as usual; and, in consequence, the list of subjects for the ensuing session had been much altered and modified, and the attention of gentlemen known to possess information on any subject, had been directed to it, with a pressing request that they would favor the Institution with the results of their experience.

The following medals and premiums were awarded:—Telford medals to Messrs. Clegg, Wyatt, Swinburne, Bruce, Hughes, Struvé, and Newton; and Council premiums of books to Messrs. Glynn, Blackwell, Leslie, and Carr.

JAMES MEADOWS RENDEL, Esq., PRESIDENT,—IN THE CHAIR.

January 18th, 1852.

The proceedings of the evening were commenced by an address from the President on taking the Chair, for the first time, after his election.

After thanking the members for the honor conferred on him by his election to the Presidential chair, the President proceeded to notice the principal engineering works recently terminated, and those now in progress, as well as the new projects in which engineering skill had been employed, or was required.

The Great Exhibition was prominently noticed,—attention

being drawn to the fact of so much of the raw material, and of the manufactured article, being shewn, with so little of the means of manufacturing; and thus the greatest portion of the lesson had been unproductive.

Turning to the more immediate occupation of the Civil Engineers, which had been styled "the application of mind to matter;" it was sought to be enforced, that all undertakings should be examined, not only with respect to their engineering possibility, but to their social and political influence on society.

The vast increase of private communication was noticed,—four hundred millions of letters being now delivered annually, instead of seventy-six millions, as before the establishment of the penny post system. Steam alone could have conveyed such a mass of correspondence.

The *increase* of population in England and the *decrease* in Ireland, afforded an opportunity for pointing out the fine field offered by the latter country for the ameliorating effects of engineering works.

Claussen's flax process, emigration, cheap branch lines of railway, drainage, and other topics, were then discussed and reasoned on. The general railway system was examined and traced, giving the principal statistical facts connected with the railways of Great Britain, the Continent, India, and the United States; in connection with which latter, the name of General Gibbs McNeill, the pupil of Telford and George Stephenson, was mentioned, as having constructed a great extent of lines. The length, direction, and purposes of the railways were given, with the principal statistical facts connected with them.

The principal ports, harbours of refuge, and general civil engineering works in Great Britain were mentioned, with some point of interest connected with each.

The electric and submarine telegraphs, with the wonderful effects they were calculated to produce on commerce, and the political relations of nations, were descanted on.

The strength of the Royal Steam Navy and the wonderful progress of the commercial steam-power of England were given, with details of the statistics of several of the principal companies; and the value of auxiliary steam and screw vessels was pointed out, with the great change now operating in the collier trade of the north.

The drainage of land and its influence on rivers, the reclaiming of lands from the sea—new modes of raising water in the fens—the sanitary regulations as applied to all large towns—agricultural engineering—its union with chemistry—increased power for water supplies to the metropolis, and the principal cities of Great Britain, and the new mineralogical discoveries of iron ore near Middlesbro'-on-Tees and Northampton, furnished topics for a brilliant display of statistical research and sound reasoning. The President, in closing his address, thus expressed himself with respect to the strike of the operative engineers:—

"At a period of such regular employment for almost all classes of artisans, and a general absence of complaint, it is unfortunate that any symptoms of dissatisfaction should have been exhibited by a body of men, whose experience, intelligence, and attainments on most subjects, induced the belief that they would be the last to listen to the evil counsels of designing agitators. Disunion between employers and the employed must ever be productive of evil to both; but it invariably ends in permanent injury to the men, whose occupation is the construction of machines by which manual labor is only apparently superseded, whilst civilization is invariably advanced by affording mankind increased powers over the materials of the world.

"It is to be fervently hoped, that the men will discard the erroneous notion, that 'capital is the foe of labor;' and that, as the employers have expressed their willingness to consider any individual representations made in a fitting manner, this unhappy dispute may be arranged without prejudice to either party."

The meeting was addressed by Mr. Scott Russell, Mr. Locke, M.P., V.P., and General Gibb McNeill, on the topics touched on by the President's address.

January 20th, 1852.

The paper read was, "*On the alluvial formations and the local changes of the South-Eastern Coast of England. Second section, from Beachy Head to Portland*,"—by Mr. J. B. REDMAN, M. Inst. C.E.

Westward of Beachy Head the effects produced by local variations in the beach were traced,—the "fulls" tailing across the outfall of Cuckmere Haven, and driving the outlet eastward, creating a barrier of beach at Seaford (at an early period the outfall of Newhaven harbour), where an ancient outlet existed, on the site of the present entrance—subsequently projected eastward, by the passage of shingle from the westward, until rendered permanent by piers. The recent degradation of the shore along Seaford Bay, from the shingle being arrested to the westward, and the unavailing attempt to stop this movement, by blasting the cliff at Seaford Head, were noticed. The waste of the coast at Rottingdean—the modern changes at Brighton—the great variations in the outlet of Shoreham Harbour, until rendered permanent by artificial works—were examined, as well as the analogous effects on the coast generally at Pagham, across the entrance of which a spit had been formed, similar to those at the ancient harbours of Romney and Pevensey. The anchorage of the Park, off Selsey Bill, once presumed to have been a portion of the site of a bishop's see, prior to its removal to Chichester, owing to the progressive waste of the shore was noticed. At the back of the Isle of Wight, the peculiarities of the land-locked harbours, and the protection afforded by the shore defences to Portsmouth harbour—so little altered, in its general outline, since the time of Henry VIII.—were described

as, also, the remarkable promontory called Hurst Point, many of the characteristics of which were similar to those of the Chesil Bank, Calshot Point, and other formations: such as a low flat shore to leeward (eastward), and a highly-inclined beach seaward, with a tendency to curve round to the northward and eastward, and eventually to inclose a tidal mere or estuary. The elevation and size of the pebbles increased towards the extremity of these points; and, in places on the sea-slope, an intermixture of coarse sand and shingle, which had become solid and homogeneous by age, cropped out through the modern beach. The remaining portion of the coast of Hampshire, and that of Dorsetshire, as far as Weymouth, were then minutely described; and the paper concluded with a particular account of the Chesil Bank, which in magnitude far exceeded all other formations of the kind, and which it was considered might be attributed to the waste of the great West Bay.

Numerous diagrams, compiled from ancient and modern maps, together with sections and sketches of the various alluvial spits along the coast, were exhibited; and it was shewn, that all these local accumulations had many features in common, and were subject to the same alternating effects of loss and gain, and were the results of causes in constant operation: the whole exercising a most important influence on harbour and marine engineering generally.

In the discussion which ensued, in which Sir C. Lyell, Sir E. Belcher, Mr. Rennie, Capt. O'Brien, Mr. Scott Russell, and the author took part, the peculiarities of the different parts of the coast were still further described; and the formation of the moles of shingle were attributed, by some of the speakers, to the action of the tidal currents; but more generally, by others, to the mechanical power of the waves alone, which appeared to account for the apparently anomalous fact, that the largest pebbles were always found on the summit and to leeward. Chesil, Hurst, and Dungeness beaches were referred to as remarkable instances of results produced by such causes; and the effect of the severe storm of November 1824, on the base of Hurst beach, was alluded to.

A short account of Mr. Deane's submarine researches on the Shambles shoal, off the Bill of Portland, was read,—describing that shoal to consist entirely of a bed of small broken shells, arranged in parallel shelves, or steps, instead of, as had been supposed, being formed of boulders and pebbles. This peculiar arrangement of light shells, at depths varying from four to nine fathoms, must be the result of the action of the currents forming a spot comparatively without motion, and induced curious speculations as to the causes of the accumulation, and the effects that might be produced on similar aggregations by artificial works.

The discussion was adjourned until Tuesday, January 27th.

INSTITUTION OF MECHANICAL ENGINEERS,
BIRMINGHAM.

(Continued from page 530, Vol. XXXIX.)

The following paper, by Mr. ARCHIBALD SLATE, of Dudley, was next read :—

New equilibrium canal lift, for transferring boats from one level to another, without loss of water or of power.

The scarcity of water in the inland navigation during the summer months, and the consequent inconvenience to the manufacturers who are dependent for an outlet on that mode of conveyance, having led the author of the present paper to the investigation of the various plans which had been proposed or tried, for transferring boats from one level to another, without the loss of water which occurs in the use of locks, he found that to the successful application of any lift or method of transferring boats, two points were essential : first, that the boats should float in water during transfer ; and next, that there should be a total absence of gates or sluices in the main line of the canal.

To make the boats float into a caisson or tank, sunk in the water, disposed of both the above points at once ; and the only thing then to be sought for was the proper mechanical arrangement by which the caisson, with the boat floating in it, might be lifted out of the water at the one level, and transferred to the other level, without the loss of water, or the use of more power than is necessary to overcome the friction of the machinery.

The method proposed for accomplishing this object is as follows :—The upper level of the canal is divided into two branches or arms, each of a sufficient width, and carried along each side of the lower level of the canal, to a sufficient length to receive an ordinary canal boat. The sides of the canal, forming the upper levels, are constructed of stone and brickwork, as in ordinary locks, or of iron carried upon timber framing. The depth of each branch of the canal is sufficient to permit a boat, with a full load, to float over the ends of a caisson or tank, of sufficient size to contain water enough to float a loaded boat.

Over these branches of the canal is erected a timber or iron framework, upon the top of which, at points immediately over the upper and lower branches of the canal, are fixed rails to receive carriages containing a series of wheels, over which run the chains for lifting the caissons.

At the bottom of one of the branches of the canal, on the upper level, and of one on the lower level, are placed the iron caissons or tanks, which are carried by straps, attached to cross bearers, and suspended by the chains at points immediately under the framework.

At one side of the framework, in two vertical grooves, a shaft,

carrying four drums, is suspended; and on these drums the lifting chains wind and unwind in the operation of raising and lowering the caissons;—the two sets of chains being wound on the respective drums in opposite directions;—so that when one caisson is raised, the other is at the same time lowered. This drum-shaft turns in bearings, carried by straps attached to equilibrium connecting chains, pendent from one of a pair of cams which are keyed fast on to a main shaft, supported in suitable fixed bearings. On the same shaft are also keyed two other cams, to which a balance-weight is attached by two chains. This shaft also carries two drums, to which two water buckets are attached on opposite sides, for the purpose of aiding, if required, the manual power in working the lift.

The balance-weight is nearly equal to the weight of the caissons in the water, when working through the shortest leverage of the cams;—the caissons being allowed a little weight in excess, in order that they may freely sink to the bottom of the water. The balance-weight, when acting through the longest leverage, is equal to balance the caissons when out of the water and full of water: the weight of the caissons is the same under all circumstances, on account of the relative displacement of water, whether they contain a loaded boat or an empty boat, or are merely filled with water, without any boat. The form of the cams between these two extreme points is regulated by the form and depth of the caissons.

The following is the action of the equilibrium lift:—Supposing two loaded boats approaching the lift, one on the upper and the other on the lower level of the canal (but the same description applies to empty boats, or to a single boat), each boat is floated into the arm of the canal, over the caisson lying at the bottom, in the same way as into ordinary locks. The first operation of lifting is to raise both caissons out of the water, with the boats floating in them. This is done by applying power to a train of wheels in connection with the main shaft: by which operation the shaft is caused to rotate and wind the equilibrium connecting chains round their cams. The drum-shaft, with its drums and suspending chains, will now move down the vertical grooves in the framework, and effect the raising of the caissons and boats out of the water. This operation may be performed either by manual power or by means of water buckets, by turning on water from the upper level into the descending bucket, and letting out the water, by a self-acting valve, on the bucket reaching the bottom. The varying weight of the caissons, in progress of being raised from the bottom to the surface, until out of the water, is allowed for, so as to preserve the equilibrium throughout the operation, by the varying leverage of the balance-weight acting upon and through the four cams; so that the power has little more than the friction of the machinery to overcome.

Having by this means lifted both caissons out of the water,

that one which is required to descend to the lower level is moved across the bank of the canal, by means of the railway on the top of the framework, in a similar manner to an ordinary traversing crane, until it is suspended over the lower branch of the canal. When in this position, a wheel on the end of the drum-shaft is geared to the train of driving-wheels, before mentioned, by means of a shifting clutch; and power being applied, the drum-shaft is caused to revolve and simultaneously unwind the chains attached to the descending caisson, and wind up those of the ascending one, whereby they will be carried to a relative position opposite to that from which they started. The caisson which has been raised from the lower level is then moved, as before, by means of the railway, across the bank of the canal, and suspended over the upper branch. The clutch is then ungeared, the power again applied to the shaft carrying the cams with the balance-weight, and the caissons are simultaneously lowered to the bottom of the canal, and the boats floated over their ends and away to their destination.

Various plans for passing boats from one level of a canal to another, by vertical lifts, have been proposed, and some partially carried out in practice. In most of these, however, there is a loss or consumption of water from the upper ponds of the canal, in excess of that consumed, or in diminution of that supplied, in passing the upward or downward trade respectively. It will be obvious that the plan above proposed occasions no waste of water; that in passing the upward trade, the water consumed is equal to the tonnage of the ascending trade; and, in the opposite direction, the water supplied to the upper ponds of the canal is equal to the tonnage of the descending trade; so that a weight of water equal to the whole downward tonnage will be absolutely transferred from the lower to the higher levels of the canal.

The difference of the levels of the two branches of a canal to which this equilibrium lift may be applied, is limited only by the strength of materials and convenience of working.

In the present system of locks, the amount of traffic on canals is really limited to the supply of water, and this in many cases is deficient for the ordinary traffic; so that any reduction of the present rates of carriage on canals becomes hopeless under the present system. But by the adoption of such a system as the one proposed, on the summit levels of canals, their capacities for traffic may be so increased as to enable them successfully to compete with the railway system, which now threatens to swamp three-fourths of the canal property in the kingdom.

This equilibrium lift may be made single or double. In its double form, it is estimated that it would pass one boat up and another down in about three to five minutes, according to the height of lift.

The value of this lift is its capacity for an almost unlimited amount of traffic, without any expense of water, instead of incurring the constant loss that attends the present locks, amounting

to more than 100 tons of water each time that a boat passes through. The enormous annual expense of water to replace the loss by the locks, on many of the canals in the Midland districts, is too well known to those acquainted with their practical working to require any observation. Supposing the proposed plan applied in several parts of the surrounding district, where there are from sixteen even to thirty locks situated close together, and the loss of time to every boat in passing the series of locks is from $2\frac{1}{2}$ to 5 hours, a most important saving of time would be effected; as, with one and two lifts respectively in those cases, the whole time required for a boat to pass would be only from 10 to 20 minutes.

The Chairman illustrated the action of the lift by a large working model. He observed that in former plans for lifts there was danger of the boat suddenly striking the surface of the water, with the momentum of descending, but that was not possible in the present plan: the boat was necessarily stopped before reaching the surface of the water, and it was then lowered into the water gradually by a second movement. The boat was guided into its situation over the caisson; and there was no danger of the boat going wrong in working the lift: even if a boat happened to be caught by the top of the caisson in lifting, no damage could be done, as the man would not be able to lift it, having only power enough to overcome the friction of the apparatus. In this plan, there was no risk of loss of water from carelessness or accident; but, in some plans, where the end of the canal was closed by a sluice, a boat striking the end, by coming in too fast, might do serious injury, and risk the loss of the water in that section of the canal.

In reply to an enquiry as to what would be the probable expense of the lift, the Chairman stated that the expense of locks might be estimated at about £1,000 each; and for a height of three locks, or 21 feet, the cost would be about £3,000, and the lift would be about the same; but the higher they went with the locks, the better would his plan be suited, and the saving proportionally greater, as most of the expense of the extra locks would be saved. He observed, that his object was to shew the applicability of the lift, leaving those interested in canals to judge of its advantages.

The following paper, by Mr. S. H. BLACKWELL, of Dudley, was next read:—

On an improved miner's safety lamp.

The improved safety lamp, which is the subject of the present paper, is the invention of Mons. F. Eloin, mining engineer, of Belgium.

Important as was the discovery by Sir Humphrey Davy, of the property possessed by thin wire gauze to prevent the passage of flame, yet it could hardly be expected that the details of any ar-

rangement embodying this principle could be at once made perfect. Attempts to improve the structure of the original Davy lamp have, therefore, been numerous; but few of them have been generally adopted; and in most of our collieries the original form of lamp is still used.

The principal defects of the common Davy lamp are, first,—deficient light, rendering the collier always unwilling to use it, unless compelled by the presence of a highly explosive atmosphere; second,—liability of injury to the gauze of the cylinder, either by a blow from a pike, a fall to the ground, or otherwise; third,—the possibility of a current of explosive atmosphere being carried through the gauze cylinder, either by the swinging of the lamp in the hand of a person when walking, or by its being exposed to the powerful blowers of gas, which are sometimes given off with great force; fourth,—the heating to redness of the gauze, by which explosions actually take place, from the contact of the explosive atmosphere with the heated wire. This danger is often increased by the presence of small particles of coal-dust, which, floating in the air of the mine, attach themselves to the gauze; and also from the deposit of soot on the gauze, arising from the imperfect combustion of the oil, which, in the common Davy lamp, always gives off a dense column of smoke.

In the improved lamp of M. Eloi these defects are obviated. In reference to light, the cylinder above the flame is closed, and air is admitted only below the flame, through a narrow breadth of gauze; but the air which is admitted is brought into actual contact with the flame, by the application of a cap, on the principle of the solar lamp; and thus perfect combustion is produced and light given off equal to at least five or six ordinary Davy lamps. As to the liability of injury to the gauze, this is obviated by using, first, a strong short cylinder of glass, through which the light passes, capped over the flame with a brass or iron cylinder, which cannot be injured except by actual violence. It might be supposed that the glass portion of the cylinder would be liable to accident; but in practice this is not found to be the case: bound, at top and bottom, by a strong brass ring, if it were even to crack, either from a blow, or from unequal expansion by heat, no danger would result, as the pieces into which it would be separated would still be held together by the brass beadings. The closed nature of the cylinder entirely prevents the passage of an explosive atmosphere into the lamp, by any current of air; no swinging of the lamp causes any action on the flame; and no blower of gas can blow into the flame, in consequence of the protection of the cylinder; all danger also, by reason of the heating to redness of the wire gauze, is entirely removed.

Besides the removal of the defects common to the Davy lamp, M. Eloi's lamp possesses, from its structure, some peculiarities that render it much safer. The air which enters through the narrow breadth of wire gauze, below the flame, being only such

as is necessary to support the flame of the wick, and the combustion being of so perfect a character, that portion of the cylinder which is above the flame must always be filled with the products of combustion, and never with an explosive atmosphere. This is clearly seen by the flame being extinguished whenever the general upward current is by any means reversed.

The weight of the lamp (always an important consideration where it has to be carried for any length of time in the hand) is not at all objectionable; and its cost in Belgium does not exceed 7 francs.

A conical brass shade is attached to, and made to slide upon, the rods surrounding the glass portion of the cylinder, by which the light can be directed downwards if wished, so as to throw the light over the floor of the mine.

SOCIETY OF ARTS.

Dec. 10th, 1861.

On the raw materials from the animal kingdom, displayed in the Great Exhibition. By RICHARD OWEN, F.R.S.

The lecturer, in commencing his discourse, pleaded his want of that special knowledge and experience which might have been looked for in a juror for the Class (IV.) of "vegetable and animal substances used in manufactures, as implements, or for ornaments;" as his studies had, until very recently, been devoted to the science of the organization of animals, rather than the application of animal substances to the arts and manufactures.

In the examination and comparison of the very numerous and diversified substances confided to their judgment, the Jury IV., over which the lecturer had the honor to preside, were guided and influenced by the consideration of the invention, ingenuity, skill, and industry manifested in the amelioration and perfection of these several substances, and by the degrees in which unfavorable conditions of soil and climate had been thereby overcome; and, in deciding on individual merits, they were careful to take into account the natural facilities which favored, and the natural difficulties which opposed, the realization of the desired qualities in the raw produce transmitted for exhibition.

Perhaps the most valuable and important of the "raw materials" which belong to the animal kingdom is wool. This is a peculiar modification of hair, characterized by fine transverse or oblique lines, from 2000 to 4000 in the extent of an inch, indicative of a minutely imbricated scaly surface, when viewed under the microscope,—on which, and on its curved or twisted form, depends its remarkable felting property, and its consequent value in manufactures.

Most quadrupeds possess the woolly variety of hair as an under clothing, but in a small proportion, and hidden by the smooth, exterior, coarser, and straighter kind of hair. In the wild sheep, the woolly variety of hair is developed in excess; and, in the domesticated races, the fleece has been modified and improved, in various degrees, by crossing the breeds, by choice of climate and pasture, and by careful attention and defence during its growth, until not only has the original coarse character of the product disappeared, but qualities of wool, of different kinds, and of different degrees of superiority, have been obtained, generally divisible into two classes,—one better adapted for “carding,” the other for “combing,” and both available for a great variety of useful and elegant textile fabrics.

Probably a more extensive, varied, and instructive collection of wools was never brought together under one roof for inspection and comparison than that which was contributed to the Great Exhibition; and it exemplified, in a remarkable degree, the extent to which pastoral life—commenced, according to oldest records, in Central Asia, the habitat of the argali—has since been spread over the globe. From the provinces of Chinese Tartary, from Thibet, and India, in the east, to the lately-redeemed tracts of the United States, in the far west—from Iceland and Scandinavia, in the north, to the Cape of Good Hope, Australia, and Tasmania, in the south, specimens of the staple of the flocks there, and in almost every intermediate latitude and longitude, preserved and multiplied under the fostering and modifying influence of civilized man, had been transmitted for inspection and comparison.

Natural history, as yet, possesses no facts or principle adequate to the satisfactory solution of the question, whether the domesticated sheep—the *ovis aries* of Linnæus—was created as such, in special relation to the exigencies of man; or whether it was the result of man's interference with the habits and wild mode of life of the argali—*ovis ammon* of Linnæus—or other untamed and unsubdued species of sheep. Analogy would point to the latter hypothesis as the more probable one. Domesticated varieties of animals have been established from wild originals for the behoof of mankind within a comparatively recent period in his history; of which the turkey, introduced and diffused over Europe and Asia since the discovery of America, is an example.

After the comparison of the wools exhibited by the growers of different nations, the jury were unanimous in making the first mention of those transmitted from Germany, as being pre-eminent in the qualities of highest value. The next degree of eminence was awarded to the United States.

The wool from the merino sheep from Spain, for which that country was once so famous, shewed all those characters which distinguished it a century ago; but not the advance and improvement made by the sheep-breeders who have since introduced the

same variety into suitable localities in Saxony, Prussia, Austria, Hungary, and Austro-Silesia.

Amongst the series of wools shewn in the French department were specimens characterized as "a wool of singular and peculiar properties,—the hair glossy and silky, similar to mohair, retaining, at the same time, certain properties of the merino breed." This wool was exhibited by J. L. Graux, of the farm of Mauchamp, Commune de Juvincourt (Aisne), as the produce of a peculiar variety of the merino breed of sheep: the circumstances connected with which are peculiarly worthy of notice.

It appears that, in the year 1828, one of the ewes of the flock of merinos in the farm of Mauchamp produced a male lamb, which, as it grew up, became remarkable for the long, smooth, straight, and silky character of the fibre of the wool, and for the smoothness of its horns: it was of small size, and presented certain defects in its conformation, which have disappeared in its descendants. In 1829, M. Graux employed this ram with a view to obtain other rams having the same quality of wool. The produce of 1830 included only one ram and one ewe having the silky quality of the wool; that of 1831 produced four rams and one ewe with the fleece of that quality; and in the year 1833 the rams with the silky variety of wool were sufficiently numerous of themselves to serve the whole flock. In each subsequent year the lambs have been of the two kinds;—one preserving the characters of the ancient race, with the curled elastic wool, only a little longer and finer than in the ordinary merinos; the other resembling the rams of the new breed: some of which retained the large head, long neck, narrow chest, and long flanks of the abnormal progenitor; whilst others combined the ordinary and better formed body with the fine silky wool. M. Graux, profiting by this partial resumption of the normal type of the merino in certain of the descendants of the mal-formed original variety, at length succeeded, by a judicious system of crossing and interbreeding, in obtaining a flock combining the long fine silky fleece, with a smaller head, shorter neck, broader flanks, and more capacious chest. Of this breed the flocks have become sufficiently numerous to enable the proprietor to sell examples of the breed for exportation. The crossing of the Mauchamp variety with the ordinary merino has also produced a valuable quality of wool, known in France as the "Mauchamp merino." The fine silky wool of the pure Mauchamp breed is remarkable for its qualities as combing wool, owing to the strength as well as the length and fineness of the fibre. It is found of great value by the manufacturers of Cashmere shawls, being second only to the true Cashmere fleece in the fine flexible delicacy of the fabric, and of particular utility when combined with the Cashmere wool, in imparting to the manufacture qualities of strength and consistence in which the pure Cashmere is deficient.

The comparatively moist climate of England is unfavorable to

the development of the highest qualities of wool. We are essentially a practical people; and it does not pay to give the sheep the extensive range, or allow them the length of life, which are amongst the conditions to be added to climate for the acquisition of the finest fleece. The interminable plains and mountain ranges of Australia and Tasmania, where the flocks graze under the most favorable of skies, serve to produce for us the wools required for our manufacturers, cheaper than they could be developed at home. Our business is to breed sheep for mutton, not for wool—to improve the stocks which in the shortest time put the most meat on the smallest bones. The fleece must always, therefore, be a secondary object with a good farmer. Nevertheless, very respectable samples of wool were exhibited in the English department of the Great Exhibition.

The best developed and most valuable examples of hair and bristles were exhibited in the Russian department. In one of the samples of horse-hair exhibited, the white hairs from the tail were forty inches in length, and of the first quality for evenness, elasticity, and shining surface. In the sample of black tails, the hairs were forty-two inches in length. Fine specimens of white hair from the mane, of from twenty-eight to thirty inches in length, both transparent and opaque, and good samples of horse-hair for furniture, both twisted and untwisted, black, grey, and white, were also shewn.

Camel's hair cloth, bristles from the wild boar and the elephant, and quills of the porcupine, were exhibited in the Indian department; and the department of Spain contained some interesting examples of the hair of the rabbit and hare, shaved off the skin by a mechanical process. The vast numbers of those prolific rodents in Spain afford a large supply of this kind of hair, which is put to the same uses as down.

The next substance spoken of was baleen, which, though commonly called "whalebone," was stated to possess nothing of the nature of bone—it being an albuminous tissue, nearly allied to hair and bristles, both in its chemical and vital properties, and its mode of development.

The cetaceans which afford the whalebone, or, more properly, baleen-plates, are of a more timid nature than the great sperm-whales: they have no teeth, but in their place they have substitutes, in the form of horny plates, ending in a fringe of bristles—a peculiarity first pointed out by Aristotle. Of these plates, the largest, which are of an inequilateral triangular form, are arranged in a single longitudinal series on each side of the upper jaw, situated pretty close to each other, depending vertically from the jaw, with their flat surfaces looking backwards and forwards, and their unattached margins outwards and inwards,—the direction of their interspaces being nearly transverse to the axis of the skull. The smaller subsidiary plates are arranged in oblique series, internal to the marginal ones. The base of each plate is hollow, and is

fixed upon a pulp, developed from a vascular gum, which is attached to a broad and shallow depression, occupying the whole of the palatal surface of the maxillary, and of the anterior part of the palatine bones. The base of each marginal plate is the smallest of the three sides of the triangle; and it is unequally imbedded in a compact sub-elastic substance, which is so much deeper on the outer than on the inner side, as in the new-born whale to include more than one-half of the outer margin of the baleen-plate. The form of the baleen-clad roof of the mouth is that of a transverse arch or vault, against which the convex *dorsum* of the thick and large tongue is applied when the mouth is closed. Each plate sends off from its inner and oblique margin the fringe of moderately stiff but flexible hairs which projects into the mouth. The bases of the baleen-plates do not stand far apart from one another; but the anterior and posterior walls of the pulp-fissure are respectively confluent with the contiguous divisions of the bases of the adjoining plates at their thin and extreme margins, which, by this confluence, close the basal end of the interspace of the baleen-plates: which interspace is occupied more than half way down the plate by the cementing substance, or gum. Thin layers of horn in like manner connect the contiguous plates, and may be traced extending in parallel curves, with the basal connecting layer across the cementing substance.

The chemical basis of baleen, according to the experienced Professor Brande, is albumen, hardened by a small proportion of phosphate of lime.

The final purpose of this singular armature of the upper jaw of the great whales is to secure the capture and retention of the small floating mollusks and crustaceans, which serve principally as their food. When the capacious mouth is opened, the water rushes in, and is strained through the fringed surface of the roof and sides; whilst the small animals are retained, bruised against the stiff bristled margins of the plates, and swallowed.

Baleen, or whalebone, from its tenacity, flexibility, elasticity, compactness, and lightness, is applied to a great variety of useful purposes. These were well exemplified in the building, which also contained specimens of the raw material in various states of preparation, and numerous and ingenious applications of the prepared baleen, dyed of different colors, for covering whip-handles, walking-sticks, and telescopes, and in the form of shavings for plating, like straws, in the construction of light hats and bonnets.

From a product of the most gigantic of animals, the lecturer next proceeded to notice one derived from a seemingly insignificant insect, viz., silk. The most valuable kind of silk, and that which is the subject of the most extensive and pains-taking culture, is a secretion of the larva of a species of moth, indigenous to China, called, *par excellence*, the "silk moth," and by entomologists *Bombyx mori*, from its native and favourite food, the leaves of the mulberry-tree.

Raw silk was imported into Europe long before the insect which produces it; but the antiquity of this raw material for the richest of our textile fabrics, by no means goes so far back as that of wool.

That silk was most abundant in China, we learn from the oldest records of the singular people inhabiting that country, where, from an early period, not only the mandarins, but all persons in easy circumstances, as well male as female, have worn silk, satin, or damask clothes. Even the uniforms of the soldiers were made then, as now, of this elsewhere considered so valuable material.

According to Procopius, the *Bombyx mori* was first introduced into Europe in the reign of the Emperor Justinian, by two Nestorian monks who had travelled in Serinda—which, whether it be India or China is uncertain—and who succeeded in bringing a quantity of eggs—secured (according to Photius) in a hollow cane—to Constantinople, where they were hatched, and the larvae fed and reared on the leaves of the black mulberry. The breeding of silkworms in Europe was confined for six centuries to the Greeks of the Lower Empire. In the twelfth century, the rearing of silkworms and the manufacture of silk were introduced by Roger, king of Sicily, into Palermo, whence this important branch of industry was rapidly and successfully established in Italy, Spain, France, England, and subsequently in most of our colonies possessing a suitable climate.

Silk is a secretion of a pair of long glandular tubes, called "sericteria," which terminate in a prominent pore or spinnaret on the under lip. Before their termination they receive the secretion of a smaller gland, which serves to glue together the two fine filaments from the two "sericteria:" the apparently single thread being, in reality, double, and its quality being affected by the equality, or otherwise, of the secreting power of the "sericteria." The silkworm commences spinning when it is full grown, in some convenient spot affording points of attachment for the first-formed thread, which is drawn from one part to the other until the body of the larva becomes loosely enclosed by the thread. The work is then continued from one thread to another, the silkworm moving its head and spinning in a zig-zag way, in all directions within reach, and shifting the body only to cover the part which was beneath it. The silken case, so formed, is called the "cocoon." During the period of spinning the cocoon—which usually takes five days for its completion—the silkworm decreases in size and length considerably; then casts its skin, becomes torpid, and assumes the form of the chrysalis.

The *Bombyx mori*, having been bred and reared under the special care and management of man during a long succession of ages, may be regarded as a domesticated species of insect; and it has become the subject, as in the higher domesticated races, of varieties, of which those called "Sina," "Syrie," and "Novi," in France, are examples.

The "Sina" variety of the silkworm is known and esteemed for the pure whiteness of its silk, the thread of which is fine, but weak, and not very lustrous. The "Syrie" variety is of large size, produces a cocoon abundant in silk, but the thread is rather coarse, inclining to a greenish tint. The "Novi" race is small, but the cocoons are firm and well made, and the silk has a yellowish tint.

The specimens of cocoons and raw silk, exhibited in the French department, were numerous, and the degrees of excellence hardly to be discriminated in the finest examples; but to the specimens of unbleached silk and silk cocoons, from the Chateau de St. Selves, near Bordeaux, exhibited by Major Count de Bronno Bronski, special notice was justly due. The cocoons were remarkable for their large size and regularity of form, and the silk for the unusual length of the thread, its natural pure white color, its fineness, and lustre. The circumstances under which this superior quality of silk was obtained are as follows:—In 1836, Major Bronski reared, separately, the eggs of the three varieties, Sina, Syrie, and Novi. In 1837, he set apart the cocoons of the varieties Syrie and Novi; and, on the exclusion of the imago, or perfect insect, he associated the males of the Novi with the females of the Syrie; and the hybrid ova were hatched at the ordinary period in 1838,—the operations being repeated in 1839 and 1840. With regard to the race Sina, M. Bronski, in 1837, separated the white from the black worms as soon as they were hatched. He then selected the largest and best-shaped cocoons, and made a special collection of the eggs from the moths excluded from those cocoons. This procedure was repeated in 1838 and 1839; but, in 1840, he associated the males excluded from the large cocoons of the black worms with the females excluded from those of the white worms. In 1841, he associated the males of the Sina race with the hybrid females obtained from the above-described crossings of Novi and Syrie breeds." By these, and similar experiments, M. Bronski at length appears to have succeeded in obtaining a race of silkworms not subject to disease, producing large and equal-sized cocoons, of a pure white color,—the silk of which was equal in all its length, strong and lustrous, and presenting an average length of thread of 1057 metres.

Very beautiful examples of raw silk were also transmitted from different parts of Italy; and, amongst the Italian silks, the first mention was due to those exhibited in Tuscany, which shewed well all the desirable qualities of the cocoons and thread.

Many of the silks exhibited in the department of Turkey were of a very fine character, exhibiting a good length of thread, with the qualities of fineness, strength, elasticity, and lustre. The jury had great pleasure in awarding the prize medal to the School of Sericulture at Broussa, as well as to some private exhibitors from Turkey.

Fine examples of silk were also shewn in the Indian and Chinese departments.

In speaking of feathers and down, the lecturer said, that a feather consists of the "quill," the "shaft," and the "vane:" the vane consists of "barbs" and "barbules."

The *quill* is pierced by a lower and an upper orifice, and contains a series of light, dry, conical capsules, fitted one upon another, and united together by a central pedicle.

The *shaft* is slightly bent: the concave side is divided into two surfaces by a middle longitudinal line, continued from the upper orifice of the quill; the convex side is smooth. Both sides are covered with a horny material, similar to that of the quill; and they enclose a peculiar white, soft, elastic substance, called the "pith."

The *barbs* are attached to the sides of the shaft, and consist of plates, arranged with their flat sides towards each other, and their margins in the direction of the convex and concave sides of the feather: consequently, they present considerable resistance to being bent out of their plane, although readily yielding to any force acting upon them in the direction of the line of the stem.

The *barbules* are given off from either side of the barbs, and are sometimes similarly barbed themselves, as may be seen in the barbules of the long feathers of the peacock's tail.

The barbules are commonly short and close-set, and curved in contrary directions; so that two adjoining series of barbules interlock together, and form the mechanism by which the barbs are compacted into the close and resisting vane of the quill, or "feather," properly so called. When the barbules are long and loose, they characterize that form of the feather which is properly called a "plume;" and such are the most valuable products of the plumage of birds, in a commercial point of view; as, *e. g.*, the plumes of the ostrich.

The lower barbs, in every kind of feather, are usually loose, forming the down, which is increased, in most birds, by what is called the "accessory plume." This is usually a small downy tuft, but varies in different species, and even in the feathers of different parts of the body of the same bird. The value of feathers, for bed-stuffing, depends upon the proportion of loose soft down that enters into their composition; and, as the "accessory plume," in the body-feathers of swans, geese, and ducks, is almost as long as the feather from which it springs, hence arises the commercial value of the feathers of these aquatic birds.

In the development of plumage, the first covering of the bird is a temporary one, consisting of bundles of long, loosely-barbed filaments, which diverge from a small quill, and, on their first appearance, are enveloped in a thin sheath, which soon crumbles away, after being exposed to the atmosphere. These down-feathers are succeeded by the true feathers, to which they bear

the same relation as wool does to hair, or the temporary to the permanent teeth. In most birds a certain proportion of the down-feathers is retained with the true feathers; and this proportion is usually greatest in the aquatic birds. It is most remarkable in the eider-duck (*Anas mollissima*); which may be compared with the sheep in regard to the quantity and quality of the softer and warmer kind of the epidermal covering. The down of the eider combines with its peculiar softness, fineness, and lightness, so great a degree of elasticity, that the quantity of this beautiful material which might be compressed and concealed between the two hands of a man will serve to stuff the coverlet of a bed.

All the varieties and modifications of the plumage of birds, serviceable in manufactures, or valued as ornaments, might be compared and studied with advantage in the Great Exhibition, which contained a comprehensive collection of feathers and down, in different states of preparation for bed-stuffing, together with a variety of articles made from those materials.

Of horns and antlers there were numerous fine and illustrative specimens transmitted to the Great Exhibition;—amongst which the collection in the Indian department merits the first notice, for the number and variety of the examples. There were shewn the dense antlers of the *Cervus Aristotelis*; of the bara sinha (*Cervus Duvaucellii*); of the sambar (*Cervus hippelaphus*); of the kaher, or barking deer (*Cervus vaginalis*, Boddaert); of the axis (*Cervus maculatus*); of the mar (*Capricornis bubalina*); and of the hog-deer (*Cervus porcinus*); there also might be seen noble specimens of the horns of the gour (*Bos cavifrons*), and of the great Arné buffalo (*Bos (bubalus) Arna*).

In Canada were shewn fine examples of the palmated antlers of the great moose or elk (*Alces Americana*); and both Egypt and the Cape contributed specimens of the horns of the rhinoceros, the buffalo, and of various antelopes.

The antlers of all the deer tribe have the same chemical and physical qualities as true bone; and the same chemical products, *e. g.* phosphorus and ammonia, may be obtained from them. The common term "hartshorn" indicates the former exclusive use of the antlers as the source from which ammonia was obtained. The density of the texture of the antler gives it value and utility for the purposes of cutlery, and for weapons and ornaments of various kinds.

The lecturer next briefly noticed ivory, tortoiseshell, pearls, nacre, and cameo and other shells, for the purpose of calling attention to the finest specimens exhibited. He then spoke of gelatine, remarking that the raw materials chiefly used in manufactures, derived from the gelatinous textures of animal bodies, may be divided, as regards their commercial value and application, into two kinds:—

1st. The gelatines and glues, properly so called, derived from the dissolution of certain animal tissues, and especially from the waste residue of parts of animals which have served for food, or for the operations of tanning, or for the fabrication, as from bones, of articles in imitation of ivory, or from the waste particles in the carving of ivory itself.

2nd. The cleansed and dried membranes of different species of fish, more especially of the sturgeon family (*Acipenseridae*), preserving a peculiar texture, on which their value in the refining of fermenting liquors more especially depends: such membranes are called "isinglass."

The most remarkable progress in the economical extraction and preparation of pure gelatines and glues from the waste remnants of the skins, bones, tendons, ligaments, and other gelatinous tissues of animals, has been made in France, where the well-organized and admirably arranged establishments for the slaughter of cattle, sheep, and horses, in large towns, give great and valuable facilities for the economical applications of all the waste parts of animal bodies. Among the beautiful productions of this industry, the specimens exhibited by its chief originator, M. L. F. Grenet, merited peculiar approbation.

Of isinglass, it was said that this raw material owes the greater part of its commercial value to its special organization, which permits its separation into extremely delicate fibres, capable of operating mechanically in the clarification of white wines and malt liquors. In order to obtain the best isinglass, care must be taken to choose the most suitable membranes of the proper species of fish, and to avoid altering their peculiar tissue in the process of drying and preparing them.

Under these two relations, the raw products exhibited in the department of Russia held the first rank.

The greater part of the gelatinous products exhibited by the English manufacturers were prepared from isinglass, and chiefly applied to articles of food.

Amongst the specimens from India there were different kinds of isinglass in the raw state, from species of fishes distinct from those of Europe which commonly afford this substance. The principal of these were from a siluroid fish, the *Polynemus plebeius*, the dried air-bladders of which possess the fine fibrous tunic which imparts the clarifying qualities that render isinglass so valuable in the manufacture of white wines and beers; and they also are well adapted for the fabrication of fine gelatines used in manufactures and confectionary.

In conclusion, the lecturer said, that whatever the animal kingdom can afford for our food or clothing, for our tools, weapons, or ornaments—whatever the lower creation can contribute to our wants, our comforts, our passions, or our pride—that we sternly exact and take at all cost to the producers. No creature is too

bulky or formidable for man's destructive energies—none too minute and insignificant for his keen detection and skill of capture. It was ordained from the beginning that we should be the masters and subduers of all inferior animals. Let us remember, however, that we ourselves, like the creatures we slay, subjugate, and modify, are the results of the same Almighty creative will—temporary sojourners here and co-tenants with the worm and the whale of one small planet. In the exercise, therefore, of those superior powers that have been intrusted to us, let us ever bear in mind that our responsibilities are heightened in proportion.

December 17th.

Chemical and pharmaceutical processes and products.

By JACOB BELL, Esq., M.P.

The lecturer confined his observations chiefly to those objects which are usually designated as drugs and chemicals. He said it was at first supposed, that chemistry and pharmacy afforded very little scope for the public competition of exhibitors; but the result had shewn that this was an erroneous impression. The large chemical manufacturers made the most magnificent display. Their enormous masses of crystals of tartaric and citric acid, the prussiates and chromates of potash, alum, sulphates of copper and iron, &c., stood forth as beacons to attract the eye to the spot where other chemicals, less conspicuous—though not less important—were exhibited. Many of the large groups of crystals were remarkable for their fantastic and elegant forms, and gave evidence of a determination, on the part of the manufacturers, to prove that the ornamental, as well as the useful, comes within their province.

Some single crystals, exhibited by Mr. Copney, were noticed, on account of the mathematical accuracy with which the normal form of the crystal is preserved. In the groups before mentioned, the crystals so intersect and crowd upon one another, that no individual crystal is perfect. To obtain a perfect crystal, a hot solution of the salt is prepared and set aside to cool; and a hair, or thread, is suspended in the solution, to favor the deposition of single crystals. A perfect crystal having been selected, and detached from any others which may be adhering to it, is replaced in the mother liquor; to which, from time to time, a small portion of a concentrated solution of the salt is added, to feed the growing crystal. If the solution be too strong, groups of small crystals are formed, which must be removed. The crystal must be turned every day so as to expose each phase of it in rotation to the same influence. This process of turning and feeding is continued regularly several months, or until the crystal has attained the size required. (Chrome, alum, sulphate of copper, sulphate of magnesia, &c., were on the table.)

The lecturer, in noticing the improvements which had of late been made in the preparation of chemicals used in the arts, referred particularly to ultramarine: a pigment, of which the only source was formerly the lapis lazuli, an expensive mineral; but which is now artificially prepared to a great extent. In 1814, Vauquelin accidentally discovered this product in pulling down a furnace in a soda-factory; and, from his examination of the substance, he identified it as ultramarine, and concluded that it might be artificially prepared. A reward was offered in France for the process. The composition of the ultramarine from lapis lazuli was known by analysis to be sulphur, silica, soda, and alumina. Yet for a long time it was suspected that these were not the only constituents. Traces of iron and carbonate of lime had been found in some specimens of lapis lazuli; but Messrs. Clement and Desormes ascertained that these were accidental impurities. It had long been known that elements, when chemically combined, often produced compounds totally different in character from the elements; yet the chemists engaged in the investigation anxiously sought for some coloring principle which seemed to have eluded their grasp. M. Guinet solved the mystery in 1828, by a synthetical experiment. He combined the four constituents, and obtained ultramarine. Robiquet, Gmelin, Persoz, and other chemists, afterwards discovered the process. The consequence of the discovery has been, that ultramarine, instead of being a rare luxury, used only by the most eminent artists for especial purposes, is introduced into almost every branch of art and manufacture, in which a bright blue pigment is required; and it may now be obtained at a price ranging from 10s. to 1s. 3d. a pound. The specimens of ultramarine, French, German, and English, held a prominent place in the Exhibition.

He next referred to Longmaid's process for treating ores and minerals; De Lardere's process for obtaining boracic acid; and Prat and Agard's improvements in the manufacture of salt; which, with M. Guinet's ultramarine process, constituted the four discoveries for which the Council medals were awarded.

An ingenious application of the science of chemistry, consisting in the manufacture of artificial essences of pears, pine-apples, and other fruits, was noticed. The introduction of these preparations originated in the discovery of the fact, that the peculiar flavor of "pine-apple rum" was due to butyric ether, which has since been obtained from the fruit itself. Further experiments led to the discovery of other artificial essences.

The lecturer next alluded to a matter of considerable importance. It appears that the manufacturers of lucifer matches are subject to a dreadful disease, occasioned by the fumes of the phosphorus, which is one of the ingredients in the manufacture. Phosphorous, as is well known, has a great affinity for oxygen, and at the ordinary temperature of the air undergoes a slow combustion, emitting

fumes of phosphoric and phosphorous acids, which, if inhaled, are very deleterious. By a process lately discovered by M. Schrötter, an Austrian chemist, phosphorous is reduced to a condition perfectly innocuous: it may be handled and even reduced to fine powder, in which state it is equally serviceable for the purposes of the manufacturer.

Mr. Bell stated, that many of the exhibitors illustrated their processes by a series of specimens, shewing the progressive changes from the raw material to the finished product. For example, in the manufacture of alum, we had alum slate in its several stages of decomposition, resulting in plumose alum, from which is derived some of the magnificent crystals before alluded to. The alum slate consists of alumina, silica, bisulphuret of iron, and bituminous matter. It exists in some deserted coal-mines. By the action of atmospheric air, the bisulphuret of iron undergoes spontaneous decomposition,—the iron attracting oxygen; and another portion of oxygen combines with the sulphur, forming sulphuric acid, part of which unites with the oxide of iron, and part with the alumina, forming plumose alum. From this plumose alum the sulphate of iron is obtained, and also the alum of commerce—potash being added to replace the iron.

The series of lakes and carmines, with the varieties of the cochineal insect, and the *opuntia cochinillifera*, on which it feeds, affords a complete and interesting illustration of this subject.

In the raw materials and drugs comprised in the materia medica, the several classes of products, &c., were collected in groups, to show the varieties. For example, there were varieties of sarsaparilla, rhubarb, scammony, opium, cloves, nutmegs, cardamoms, with gums, resins, seeds, oils, barks, &c. Many of these objects were also exhibited among the collections of the localities whence they are derived; and it is worthy of remark, that in many instances the latter specimens were inferior to those in the English collection—an illustration of the fact that the commercial enterprise existing in this kingdom attracts the best of everything from all parts of the world, in the same manner as our metropolitan fish-market attracts the best fish from the sea-side. As soon as the value of any product or commodity is known, it generally finds its way to England.

The Indian collection contained many chemical and pharmaceutical products which might be advantageously introduced into this country; and it appears that negotiations are already in progress for the extension of trade in that quarter.

British Guiana furnished numerous products: amongst these was the meal of the bitter cassava (*janipha manihot*), which is separated from the juice by pressure. The juice in its original state is poisonous, but by boiling and fermentation it is deprived of its deleterious properties, and converted into a condiment called cassareep. It is estimated that an acre of ground devoted to the

cultivation of the bitter cassava would yield a gross return of above £78, reckoning the meal at 1*d.*, the cassareep at 1*s* 5*d.* a pound, and the starch at 40*s.* a hundred-weight.

The Great Exhibition has furnished numerous contributions to museums illustrating art, science, and industry. Among these, the British Museum, the Museum at Kew, and the Museum of Economic Geology, may be mentioned as the three public institutions which have participated. Among the chartered, or private societies, are the Chemical, Pharmaceutical, Geological, Linnean, and Zoological. In these institutions the specimens are preserved for reference and examination by those who are interested in the several subjects illustrated.

In conclusion, the lecturer adverted to the probable influence of the Great Exhibition in promoting education in chemistry and pharmacy, by drawing attention to the importance of institutions in which these branches of science are taught. In the present state of the law in this country, he said no school of chemistry or pharmacy can exist, unless liberally assisted by donations and subscriptions. Even the Royal College of Chemistry, notwithstanding the prestige of the name of Prince Albert as its head, would have been in the "*Gazette*" long ago if it had not been sustained by royal munificence and public liberality. The school at the Museum of Economic Geology, is almost entirely supported by public funds. The school of the Pharmaceutical Society has been kept up for some years at an expense of several hundreds per annum.

Those who have examined the chemical and pharmaceutical products in the Exhibition, must be aware of the necessity of some special training and education for those who are engaged in this branch of scientific industry; yet the law neither requires any qualification, nor recognizes it where it exists. The pharmaceutical chemists have been endeavouring for several years to obtain a remedy for this defect. From the time that the Great Exhibition was first proposed, the lecturer considered it a move in the same direction. It afforded the opportunity for a honorable competition between British chemists and the chemists of other nations, and for useful interchange of ideas between persons engaged in the same pursuits; it was calculated to promote harmony and good fellowship through the medium of scientific and commercial intercourse; and its general tendency was to unite, and strengthen, the hands of those who, in their several departments, are engaged in the advancement of science, and its application to commerce and the arts.

Disclaimers & Amendments OF PARTS OF INVENTIONS

Made under Lord Brougham's Act,—subsequent to March, 1851.

- Disclaimer entered by George Philbrick Swinborne and Richard Archer Wallington (assignees of the patent) with the Clerk of the Patents for England, on the 3rd day of May, 1851, to part of the title of a patent granted to the said George Philbrick Swinborne, for "improvements in the manufacture of gelatinous substances *and in the apparatus to be used therein*," dated 24th November, 1847,—whereby they disclaim the words "*and in the apparatus to be used therein*."
- Disclaimer entered on the 18th May, 1851, to part of the specification of a patent, by James Loveday, of Warwick, Gent., assignee of a patent granted to John Buchanan, on the 28th day of December, 1840, for "certain improvements in wheel carriages, whether for common roads or railways."
- Disclaimer entered on the 18th June, 1851, to part of the specification of a patent, by Peter Fairbairn, of Leeds, machine-maker, as sole proprietor of a patent granted to him and one Peter Carmichael, on the 2nd day of October, 1846, for "improvements in machinery for drawing, roving, and spinning flax, hemp, silk, and other fibrous substances."
- Disclaimer entered on the 27th June, 1851, by Celeste Menotti, of Paris, Gentleman, to part of the title of a patent, granted to him on the 27th December, 1850, for "certain chemical compositions for rendering cotton, linen, woollen, silk, and other fabrics impervious to water, *and fixing colors in dyeing*,"—whereby he disclaims the words "*and fixing colors in dyeing*."
- Disclaimer entered on the 20th day of May, 1851, by John William Hyren, of Bromley, in the county of Middlesex, manufacturing chemist, to part of the specification of a patent granted to him on the 26th day of June, 1840, for "improvements in the manufacture of oxalic acid."
- Disclaimer and memorandum of alteration entered on the 10th June, 1851, by Charles Hancock, of Grosvenor-place, artist, to part of the specification of a patent, granted to him on the 15th day of May, 1844, for "certain improvements in cork and other stoppers; and a new composition or substance which may be used as a substitute for, and in preference to, cork; and a method or methods of manufacturing the said new composition or substance into bungs, stoppers, and other useful articles."
- Disclaimer entered on the 25th July, 1851, by Peter Fairbairn, of Leeds, machine-maker, to part of the specification of a patent granted to him on the 26th day of October, 1848, for "improvements in machinery for heckling, carding, drawing, roving, and spinning flax, hemp, tow, silk, and other fibrous substances."

Disclaimer entered on the 30th September, 1851, by Louis Brunier, of Paris, civil engineer, to part of the title of a patent granted to him on the 31st day of March, 1851, for "improvements in obtaining power, by the use of *steam or* compressed air,"—whereby he disclaims the words "*steam or*."

Disclaimer entered on the 27th October, 1851, by John Beattie, of Liverpool, engineer, to part of the specification of a patent granted to him on the 5th day of September, 1851, for "certain improvements in steering vessels."

Disclaimer and memorandum of alteration entered on the 19th November, 1851, by John Bennet Lawes, of Rothamstead, in the county of Hertford, Gentleman, to part of the specification of a patent granted to him on the 23rd day of May, 1842, for "certain improvements in manures."

Disclaimer and memorandum of alteration entered on the 2nd day of December, 1851, by Edward Tann, sen., Edward Tann, jun., and John Tann, of Minerva-terrace, Hackney-road, iron safe manufacturers, to part of the specification of a patent granted to them on the 25th day of November, 1843, for "certain improvements in locks and latches; and in iron rooms, doors, safes, chests, and other repositories."

List of Patents

That have passed the Great Seal of IRELAND, from the 17th December, 1851, to the 17th January, 1852, inclusive.

To George Fergusson Wilson, managing director of Price's Patent Candle Company, Vauxhall, David Wilson, of Wandsworth, Esq., James Childs, of Putney, Esq., and John Jackson, of Vauxhall, Gent., all in the county of Surrey, for improvements in presses and matting, and in the process of, and apparatus for, treating fatty and oily matters, and in the manufacture of candles and night-lights.—Sealed 19th December.

Alphonse René Le Mire de Normandy, of Judd-street, in the county of Middlesex, Gent., and Richard Fell, of the City-road, in the same county, engineer, for improved methods of obtaining fresh water from salt water, and of concentrating sulphuric acid.—Sealed 22nd December.

Charles Watt, of Kennington, in the county of Surrey, chemist, for improvements in the decomposing of saline and other substances, and separating their component parts, or some of them, from each other; also in the forming of certain compounds or combinations of substances; and also in the separating of metals from each other, and in freeing them from impurities.—Sealed 22nd December.

Antoine Dominique Sisco, of Slough, for improvements in the manufacture of chains, and in combining iron with other

metal, applicable to such and other manufactures.—Sealed 3rd January.

Mathew Gibson, of Wellington-terrace, Newcastle-upon-Tyne, for improvements in machinery for pulverizing and preparing land.—Sealed 3rd January.

List of Patents

Granted for SCOTLAND, from the 22nd December, 1851, to the 22nd January, 1852.

To William Dickenson, of Blackburn, in the county of Lancaster, machine-maker, for certain improvements in machinery or apparatus for manufacturing textile fabrics.—Sealed 22nd December.

Augustus Applegath, of Dartford, for improvements in machinery used for printing.—Sealed 22nd December.

James Macnee, of Glasgow, for improvements in the manufacture or production of ornamental fabrics.—Sealed 26th December.

Jean Antoine Farina, of Paris, proprietor, for a process of manufacturing paper from a certain material.—Sealed 26th December.

Frances Hastings Greenstreet, of Albany-street, Mornington-creascent, London, for improvements in coating and ornamenting zinc,—being a communication.—Sealed 29th December.

Frederick Rosenborg, of the Albany, London, for improvements in the manufacture of casks, barrels, and other like articles; and the machinery employed therein.—Sealed 2nd January.

James Aikman, of Paisley, calenderer, for improvements in the treatment or finishing of textile fabrics and materials.—Sealed 6th January.

James Gathercole, of Eltham, in the county of Kent, for improvements in the manufacture and ornamenting of envelopes,—parts of which improvements are applicable to other descriptions of stationery; and in the machinery, apparatus, or means to be used therein,—being a communication.—Sealed 8th January.

Edwin Rose, of Manchester, engineer, for certain improvements in boilers for generating steam.—Sealed 9th January.

Thomas Richardson, of Newcastle-upon-Tyne, for improvements in the manufacture or preparation of magnesia and some of its salts.—Sealed 12th January.

James Warren, of Montague-terrace, Mile End-road, London, for improvements applicable to railways and railway carriages; and improvements in paving.—Sealed 13th January.

Alexander Parkes, of Birmingham, for improvements in separating silver from other metals.—Sealed 13th January.

Alexander Hediard, of 25, Rue Taitbout, Paris, for improvements in propelling and navigating ships, boats, and vessels, by steam and other motive power.—Sealed 16th January.

New Patents

SEALED IN ENGLAND.

1851-2.

- To Robert Beck Froggart, of Sale Moor, in the county of Chester, manufacturing analytical chemist, for improvements in the preparation of certain compounds to be used for the purpose of rendering woven and textile fabrics, paper, leather, wood, or other materials or substances, waterproof and fireproof; and also in machinery or apparatus employed therein. Sealed 31st December—6 months for enrolment.
- Francis Hastings Greenstreet, of Albany-street, Mornington-crescent, for improvements in coating and ornamenting zinc. Sealed 31st December—6 months for enrolment.
- George Gwynne, of Hyde-park-square, in the county of Middlesex, Esq., and George Fergusson Wilson, managing director of Price's Patent Candle Manufactory, Belmont, Vauxhall, for improvements in treating fatty and oily matters; and in the manufacture of lamps, candles, night-lights, and soap. Sealed 31st December—6 months for enrolment.
- George Collier, of Halifax, in the county of York, mechanic, for improvements in the manufacture of carpets and other fabrics,—being a communication. Sealed 31st December—6 months for enrolment.
- Francis Clark Monatis, of Earlstown, in the county of Berwick, builder, for an improved hydraulic syphon. Sealed 31st December—6 months for enrolment.
- David Napier, of Millwall, engineer, for improvements in steam-engines. Sealed 31st December—6 months for enrolment.
- Joseph Addenbrooke, of Bartlett's-passage, in the city of London, envelope manufacturer, for improvements in the manufacture of envelopes; and in machinery used therein. Sealed 8th January—6 months for enrolment.
- Charles Dickson Archibald, of Portland-place, in the county of Middlesex, Esq., for improvements in the manufacture of bricks, and other articles made of plastic materials, and in cutting, shaping, and dressing the same; as also stone, wood, and metals; and in machinery and apparatus employed therein,—being a communication. Sealed 8th January—6 months for enrolment.
- Thomas Barnett, of the town of Kingston-upon-Hull, grocer, for improvements in machinery for grinding wheat and other grain. Sealed 8th January—6 months for enrolment.
- William Cook, of the town or borough of Kingston-upon-Hull, working copper-smith, for certain improvements in the construction of steam-engines, consisting of a rotatory circular valve, for the regular admission of steam from the boiler alter-

- nately into the chambers of the two cylinders of double-acting engines. Sealed 12th January—6 months for inrolment.
- Alcide Marcellin Duthoit, of Paris, in the Republic of France, statuary, for an improved chemical combination of certain agents for obtaining a new plastic product. Sealed 12th January—6 months for inrolment.
- Robert John Smith, of Islington, in the county of Middlesex, Gent., for certain improvements in machinery or apparatus for steering ships and other vessels. Sealed 13th January—6 months for inrolment.
- Jean Antoine Farina, of Paris, in the State of France, proprietor, for a process for manufacturing paper. Sealed 13th January—6 months for inrolment.
- James Aikman, of Paisley, in the county of Renfrew, N.B., calenderer, for improvements in the treatment or finishing of textile fabrics and materials. Sealed 20th January—6 months for inrolment.
- James Macnee, of Glasgow, N.B., merchant, for improvements in the manufacture or production of ornamental fabrics. Sealed 20th January—6 months for inrolment.
- Thomas Kennedy, of Kilmarnock, N.B., gun manufacturer, for improvements in measuring and registering the flow of water and other fluids. Sealed 20th January—6 months for inrolment.
- Peter Armand Le Comte de Fontainemoreau, of South-street, Finsbury, for certain improvements in treating fibrous substances, —being a communication. Sealed 20th January—6 months for inrolment.
- Henry Graham William Wagstaff, of Bethnal-green, in the county of Middlesex, candle-maker, for improvements in the manufacture of candles. Sealed 20th January—6 months for inrolment.
- Peter Wright, of Dudley, in the county of Worcester, vice and anvil manufacturer, for improvements in the manufacture of anvils. Sealed 20th January—6 months for inrolment.
- John Whitehead, the younger, of Elton, near Bury, in the county of Lancaster, dyer and finisher, and Robert Diggle, of the same place, foreman, for improvements in bleaching and dyeing, and in washing, souring, and other processes connected therewith. Sealed 20th January—6 months for inrolment.
- George Lowe, of Finsbury-circus, in the City of London, civil engineer, and Frederick John Evans, of Horseferry-road, Westminster, civil engineer, for their invention of improvements in the manufacture of gas for the purposes of illumination; and of improvements in the purification of gas; and of improved modes of treating the products arising from the manufacture of gas. Sealed 20th January—6 months for inrolment.
- Peter Armand Le Comte de Fontainemoreau, of South-street, Finsbury, London, for certain improvements in railways and loco-

- motive engines; which said improvements are also applicable to every kind of transmission of motion,—being a communication. Sealed 22nd January—6 months for inrolment.
- Edward Tyer, of Queen's-road, Dalston, in the county of Middlesex, Gent., for certain improvements in the means of communication by electricity, and apparatus connected therewith. Sealed 22nd January—6 months for inrolment.
- James Pillans Wilson and George Fergusson Wilson, of Wandsworth, in the county of Surrey, Gents., for improvements in the preparation of wool for the manufacture of woollen and other fabrics, and in the process of obtaining materials to be used for that purpose,—being a communication. Sealed 22nd January—6 months for inrolment.
- Walter Marr Brydone, of Boston, in the county of Lincoln, for improvements in apparatus for signal and other lights for railways. Sealed 22nd January—6 months for inrolment.
- Thomas Richardson, of Newcastle-upon-Tyne, for improvements in the manufacture of magnesia and some of its salts. Sealed 23rd January—6 months for inrolment.
- George Stacey, of Uxbridge, in the county of Middlesex, machinist, for certain improvements in machinery for reaping, mowing, and delivering dry or green crops. Sealed 24th January—6 months for inrolment.
- William Pidding, of the Strand, in the county of Middlesex, Gent., for improvements in the manufacture, preparation, and combination of materials or substances for the production of fuel, and for other useful purposes to which natural coal can be applied. Sealed 24th January—6 months for inrolment.
- Frank Clark Hills, of Deptford, in the county of Kent, manufacturing chemist, for improvements in manufacturing and purifying certain gases, and in preparing certain substances for purifying the same. Sealed 24th January—6 months for inrolment.
- Joseph Jones, of Bilston, in the county of Stafford, furnace-builder, for an improvement or improvements in furnaces used in the manufacture of iron. Sealed 24th January—6 months for inrolment.
- Richard Ford Sturges, of Birmingham, in the county of Warwick, manufacturer, for an improved method or improved methods of ornamenting metallic surfaces. Sealed 24th January—6 months for inrolment.
- John Hinks, of Birmingham, manufacturer, and Eugene Nicolle, of Birmingham, aforesaid, civil engineer, for certain improved machinery to be used in the manufacture of nails, rivets, bolts, or pins, and screw-blanks. Sealed 24th January—6 months for inrolment.
- Peter Armand Le Comte de Fontainemoreau, of South-street, Finsbury, for certain improvements in lithographic, typographic, and other printing presses; which improvements are

also applicable, with certain modifications, to extracting saccharine, oleaginous, and other matters, and to compressing in general,—being a communication. Sealed 24th January—6 months for enrolment.

James Gathercole, of Eltham, in the county of Kent, envelope manufacturer, for improvements in the manufacture and ornamenting of envelopes; parts of which improvements are applicable to other descriptions of stationery; and in the machinery, apparatus, or means to be used therein. Sealed 24th January—6 months for enrolment.

Arad Woodworth 3rd, and Samuel Mower, of the State of Massachusetts, of the United States of North America, for certain new and useful improvements in machinery for manufacturing bricks, tiles, or other articles of a similar character. Sealed 24th January—6 months for enrolment.

Alfred Richard Corpe, of Kensington, in the county of Middlesex, Gent., for improvements in trowser-strap fasteners. Sealed 24th January—6 months for enrolment.

George Kent, of the Strand, in the county of Middlesex, patentee of the rotary knife-cleaner, for certain improvements in apparatus for sifting cinders, and in apparatus for cleaning knives. Sealed 24th January—6 months for enrolment.

Joseph Maudslay, of the firm of Maudslay, Son, and Field, of Lambeth, in the county of Surrey, engineers, for improvements in steam-engines, which are also applicable, wholly, or in part, to pumps, and other motive machines. Sealed 26th January—6 months for enrolment.

Edward Simons, of Birmingham, tallow-chandler, for certain improvements in lighting. Sealed 27th January—6 months for enrolment.

William Brindley, of Queenhithe, for improvements in the manufacture of flocked fabrics, and in the manufacture of buttons. Sealed 27th January—6 months for enrolment.

William Dray, of Swan-lane, Upper Thames-street, in the City of London, agricultural implement maker, for improvements in reaping-machines,—being a communication. Sealed 27th January—6 months for enrolment.

George Duncan, of the New North-road, Hoxton, and Arthur Hutton, of Herbert-street, New North-road, Hoxton, for improvements in the manufacture of casks. Sealed 27th January—6 months for enrolment.

Nelson Smith, of New York, in the United States of America, Gent., for improvements in the construction of violins and other similar stringed musical instruments,—being a communication. Sealed 27th January—6 months for enrolment.

Jean Benjamin Coquatrix, of Lyons, in the Republic of France, merchant, for improved apparatus for lubricating machinery. Sealed 27th January—6 months for enrolment.

James Joseph Brunet, of the Canal Iron Works, Poplar, in the

- county of Middlesex, engineer, for certain improved combinations of materials in ship-building,—being a communication. Sealed 27th January—6 months for enrolment.
- Alexander Mills Dix, of Salford, brewer, for certain improvements in the method of ventilating apartments or buildings, and in the apparatus connected therewith. Sealed 27th January—6 months for enrolment.
- Thomas Lambert, of Hampstead-road, in the county of Middlesex, piano-forte manufacturer, for certain improvements in piano-fortes. Sealed 27th January—6 months for enrolment.
- Julian Bernard, of Guildford-street, Russell-square, in the county of Middlesex, Gent., for improvements in the manufacture or production of boots and shoes, and in materials, machinery, and apparatus connected therewith. Sealed 27th January—6 months for enrolment.
- Joseph Vincent Melchior Raymondi, of Paris, in the Republic of France, machinist, for certain improved statistic and descriptive maps. Sealed 27th January—6 months for enrolment.
- Isac Lewis Pulvermacher, of Vienna, engineer, for improvements in galvano-electric, magneto-electric, and electro-magnetic apparatus, and in the application thereof to lighting, telegraphic, and motive purposes. Sealed 29th January—6 months for enrolment.
- François Jules Manceaux, of Paris, in the Republic of France, gun-manufacturer, for improvements in fire-arms, and in instruments and apparatus used in connection therewith. Sealed 29th January—6 months for enrolment.
- Joseph Maximilian Ritter Von Winiwarter, of Surrey-street, Strand, in the county of Middlesex, Doctor of Law, for certain improvements in the locks of fire-arms and cannon; and in gun-matches, or in the mode of igniting gunpowder used in guns; and in machinery for manufacturing the same, Sealed 29th January—6 months for enrolment.
- William Smith, of Kettering, in the county of Northampton, agricultural implement-maker, for improvements in apparatus for cutting or breaking lump-sugar and other vegetable substances. Sealed 29th January—6 months for enrolment.
- Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in the manufacture of pigment or paints,—being a communication. Sealed 29th January—6 months for enrolment.
- Edward Highton, of Clarence Villa, Regent's-park, in the county of Middlesex, civil engineer, for improvements in electric telegraphs. Sealed 29th January—6 months for enrolment.
- Isham Baggs, of Liverpool-street, in the county of Middlesex, electrical engineer, for improvements in crushing gold quartz and metallic ores. Sealed 29th January—6 months for enrolment.

CELESTIAL PHENOMENA FOR FEBRUARY, 1852.

D. H. M.		D. H. M.	
1	Clock before the ☉ 13m. 50s.	14	— Jupiter, R. A., 15h. 20m. dec. 17. 16. S.
—	☽ rises 0h. 34m. A.	—	Saturn, R. A., 1h. 52m. dec. 9. 3. N.
—	☽ pass mer. 8h. 39m. A.	—	Uranus, R. A., 1h. 56m. dec. 11. 23. N.
—	☽ sets 3h. 45m. A.	—	Mercury pass mer. 22h. 56m.
2 28 46	☿'s first sat. will im.	—	Venus pass mer. 2h. 17m.
3	Occul. 63 Geminorum, em 6h. 36m. im. 7h. 42m.	—	Mars pass mer. 10h. 22m.
22 16	♀ in the descending node	—	Jupiter pass mer. 17h. 43m.
4 4 56	♂ in conj. with the ☽ diff. of dec. 3. 18. N.	—	Saturn pass mer. 4h. 17m.
22 12	☿'s first sat. will im.	—	Uranus pass mer. 4h. 20m.
5	Clock before the ☉ 14m. 17s.	2 5	♀ in Aphelion.
—	☽ rises 4h. 35m. A.	15	Clock before the ☉ 14m. 27s.
—	☽ pass mer. Morn.	—	☽ rises 4h. 27m. M.
—	☽ sets 7h. 36m. M.	—	☽ pass mer. 8h. 31m. M.
6 53	Ecliptic oppo. or ☉ full moon	—	☽ sets 0h. 33m. A.
7 4 0	☽ in Perigee	16	Ceres stationary
10	Clock before the ☉ 14m. 31s.	17 19 43	♀ in conj. with the ☽ diff. of dec. 0. 25. N.
—	☽ rises 11h. 30m. A.	19 6 15	☿'s first sat. will im.
—	☽ pass mer. 4h. 8m. M.	20	Clock before the ☉ 14m. 5s.
—	☽ sets 9h. 53m. M.	—	☽ rises 7h. 45m. M.
11	Occul. 0 ^a Libra, em. 16h. 25m. im. 17h. 8m.	—	☽ pass mer. 0h. 41m. A.
3 17	☿ in ☐ with the ☉	—	☽ sets 5h. 45m. A.
19 19	☿ in conj. with the ☽ diff. of dec. 3. 16. S.	5 26	☿'s second sat. will im.
12 10 3	☽ in ☐ or last quarter	0 54	Ecliptic conj. or ● new moon
13 2 53	☿'s second sat. will im.	22 11 42	♀ in conj. with the ☽ diff. of dec. 4. 52. N.
14	Mercury, R. A., 20h. 26m. dec. 20. 29. N.	23	☽ in Apogee
—	Venus, R. A., 23h. 52m. dec. 1. 50. S.	24 2 17	☿'s third sat. will em.
—	Mars, R. A., 7h. 59m. dec. 24. 57. N.	10 46	♄ in conj. with the ☽ diff. of dec. 2. 52. N.
—	Vesta, R. A., 22h. 20m. dec. 14. 34. S.	11 49	♄ in conj. with the ☽ diff. of dec. 4. 17. N.
—	Juno, R. A., 20h. 39m. dec. 10. 58. S.	25	Clock before the ☉ 13m. 26s.
—	Pallas, R. A., 3h. 29m. dec. 18. 11. S.	—	☽ rises 9h. 17m. M.
—	Ceres, R. A., 6h. 9m. dec. 30. 38. N.	—	☽ pass mer. 4h. 9m. A.
		—	☽ sets 11h. 15m. A.
		16 48	♂ greatest hel. lat. N.
		26 21 36	Vesta in conj. with the ☉
		23 2 37	☿'s first sat. will im.
		5 31	☽ in ☐ or first quarter.

J. LEWTHWAITE, Rotherhithe.

THE
LONDON JOURNAL,
AND
REPERTORY
OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXLIII.

RECENT PATENTS.

To JAMES HOWARD, of the *Britannia Iron Works, Bedford*,
agricultural implement maker, for improvements in ploughs
and other implements or machines used in the cultivation
of the soil.—[Sealed 3rd July, 1851.]

THIS invention consists, firstly, in improvements in the means employed for connecting the share to the plough, and adjusting it to the required position for entering the soil; secondly, in an improved construction of coulter for ploughs; thirdly, in improvements in the construction of subsoil ploughs; fourthly, in an improved manufacture of wheels for ploughs and other agricultural implements; and, fifthly, in an improvement applicable to jointed harrows.

In Plate V., fig. 1, represents, in side elevation, an iron plough, with the mould-board removed, to shew the construction of the parts employed for connecting the share to the plough-frame; and fig. 2, is a sectional plan view, taken in the line 1, 2, of fig. 1. In these figures it will be seen, that the lever-neck enters a socket formed in the share; and that a screw-hook or share-rod is employed for holding the share upon the lever; but the construction of the lever itself is somewhat peculiar. This lever is shewn at *a, a*. Instead of connecting the lever to the plough-frame *b, b*, by passing a loose pin through corresponding holes in the lever and the frame, a fulcrum-pin *c*, is permanently fixed in the lever-neck *a*; and this pin is made to rest in bearings at the forward end of the frame. At its hind end the lever carries a clamp-piece *d*, with a ribbed face, which is made to bear against

corresponding ribs on the hind end of the frame *b*, by means of a binding-nut *e*, working on the hind extremity of the lever *a*, which is tapped with a screw-thread for that purpose. It will now be understood that, in order to adjust the position of the share, it is merely necessary to loosen the binding-nut *e*, and shift the clamp *d*, higher up or lower down, as required. By this means the angle of inclination of the lever-neck, and, consequently, that of the share with the ground, will be changed; and, by tightening the nut, these parts will be made to retain their position. It will also be understood that, by the fulcrum of the lever-neck being advanced to the extremity of the plough-frame, the movement of the lever, whether into a higher or lower position, does not alter the relative height of the top of the share and the breast or furrow-turner, as when the fulcrum (according to the ordinary construction) is set further back in the frame. Instead of making the shares and levers separate, the patentee sometimes welds them together, or forms them in one piece, as shewn at figs. 3, and 4; thereby increasing the strength of the parts and obviating the necessity for the share-rod, as well as saving the expense of forming a socket to the share. In other respects, the lever is similar to that before described.

The second part of the invention consists in making plough-coulters out of oval or oblong instead of round bars, by which means greater strength, with less weight of metal, is obtained. It is well known that the principal strain on the coulter is not lateral, but in a line with the plough's progress; the coulter-stem is therefore formed with an increased thickness of metal to meet this strain, by making the coulter of oval or oblong bar-iron; and suitably-shaped lugs, for holding the coulter to the plough-beam, are provided.

The third part of the invention refers, as before stated, to improvements in subsoil-ploughs. Fig. 5, represents, in side elevation, a plough constructed according to this part of the invention; and fig. 6, is a plan view of the same. The improvements in this implement consist, firstly, in employing, in its construction, two beams *a, a*, which are connected together by bolts or rods *b, b, b*, and thereby form one rigid frame. The plough is provided with coulters *c, c, c*, set parallel to each other, at equal distances apart, but at different distances from the plough-head. The central coulter is provided with side pieces, which admit of its being bolted to both beams; and the other coulters have also a solid bearing, by being bolted to the side of the beams. The advantage of the double beam is, that it offers great facility for fixing the

coulters and wheels, which is a point of considerable importance, as great steadiness in the working of the implement is thereby ensured. The second improvement in the subsoil-plough consists in providing two wheels *d, d*, for running in the same track on the land or unploughed ground, while one wheel *e*, runs in the furrow. By this means, the wheels take a wider bearing, and, consequently, enable the plough to work more steadily than when all the wheels run in the furrow. When steadiness of movement is obtained, greater uniformity of depth is ensured, and the power required to work the implement is consequently lessened.

The fourth part of the invention consists in a new construction of cast-iron wheel, for ploughs and other agricultural implements. This improvement is shewn at fig. 7, which represents the improved wheel in cross section. The novelty consists in casting the wheel with a hollow conical boss, having a stopped forward end, and a flange or lip at its hinder end, to receive a cap, in the manner of what are known as "patent axle-boxes." On the axle *a*, which is inserted in the box *b*, is a shoulder, which fits a recess cast in the boss or box; and, abutting upon the other side of this shoulder, is the cap *c*, which is fastened to the flange of the box by screws. In the stopped end of the box a hole is made, for the introduction of oil; and this hole is tapped to receive a screw *d*, which forms a plug for retaining the oil in the box. When a fresh supply of oil is required, the screw is taken out, and the axle is readily supplied with oil.

The last part of the invention refers to means of temporarily converting jointed harrows into rigid or fixed harrows, for the purpose of rendering them more effective in situations where the fixed harrow is preferred to be used. This object may be attained in various ways; but at figs. 8, and 9, the arrangement preferred by the patentee is shewn. It consists simply of a chain *a*, and a tightening screw *b*, attached thereto. From the jointed bar *c*, of the harrow, two pins *d, d*, project; and, to one of these, the chain is attached; while the tightening screw passes through an eye in the other, and is held in connection therewith by binding or locking-nuts. When, therefore, the implement is intended to be used as a jointed harrow, the chain is left slack; but, when it is required to be made rigid, the chain is tightened up, and the shoulders of the hinge are brought into contact. The same object might be attained by driving a bolt or pin through two staples, formed on the shoulder of the hinge or other parts of the jointed bar *c*; or a hooked rod might be used in lieu of the

chain and tightening screw. It is stated, that many other plans, more or less efficient, might be adopted for obtaining the same end.

The patentee claims, First,—the means hereinbefore described for connecting the share to the plough, whereby the share may be adjusted to its required position; and, particularly, he claims the use of a screw and nut, or other mechanical equivalent, for tightening the lever-neck lengthwise; and also providing the lever-neck with a fixed fulcrum-pin, and causing the fulcrum to rest in a socket or bearings, formed in the forward end of the frame. Secondly,—the improved construction of coulter, as above described. Thirdly,—the improved arrangement of subsoil-plough, as above described. Fourthly,—the improved manufacture of cast-iron wheels, as above described. And, Lastly,—the application to jointed harrows of the means above set forth, or any analogous means, for giving a temporary rigidity to the jointed or hinged bars of such implements.—[Inrolled January, 1852.]

To ROBERT ADAMS, of King William-street, in the City of London, gun-maker, for improvements in rifles and other fire-arms,—being partly a communication.—[Sealed 24th February, 1851.]

THIS invention refers, firstly, to improvements in the construction of rifle-barrels of fire-arms; secondly, to improvements in the construction of gun and pistol-locks; thirdly, to improvements in the construction and arrangement of safety-bolts or catches, applied to fire-arms; fourthly, to improvements in the construction of guns or other fire-arms, arranged to load at the breech; and, fifthly, to improvements in the construction of fire-arms, having only one fixed barrel, with a series of loading chambers which revolve upon a centre, so as to bring each chamber successively in a correct line with the barrel.

The improvements in the construction of rifle-barrels consist, firstly, in forming raised ridges on their inner surface, in place of grooves, or the ploughed hollow, commonly called "rifling." These ridges are preferred to be angular, as shewn by the section of a barrel in Plate V., at fig. 1; but the shape and number of such ridges may be varied. *a, a*, are the projecting ridges, which are to be made in a spiral direction, similar to that heretofore resorted to for the grooves. *b, b*, are the grooves, which have a considerable extent of width, as com-

pared with the more narrow ridges. Three ridges are, by preference, used, at equal distances apart; and the balls intended for the barrels should be cast with notches or grooves, to fit the barrels. By this arrangement, it is said, that no patches are required to be used with the balls.

Another improvement in the construction of the barrels of fire-arms consists in forming them, near the breech, with an internal hollow projection (coned on the outside, as at *a*, fig. 2,) upon which, the ball, having a recess at one end, corresponding in shape to the projection, is placed. The passage or chamber, from the end of the projection *a*, to the priming, is made of the proper dimensions to receive the charge of powder suitable for such fire-arm; and the charge may be placed therein by inverting the barrel over the end of a tubular ramrod, into which the proper charge of powder has been first put, and then turning the barrel on end, so as to discharge the contents of the ramrod into the breech; or the ramrod may be tubular, so as to allow the powder to be poured through it. The ball is next rammed down on to the projection *a*; and thus the powder is effectually retained.

Fig. 3, shews a back view of a bar or front-action lock, constructed according to the second part of the invention; and figs. 4, 5, and 6, shew the parts of the lock detached. This lock is composed of four separate parts only, viz., a hammer or cock *a*, a plate *b*, a spring *c*, and a screw *d*. The cock *a*, works on a pivot or axle *b*³, attached to, and forming part of, the plate *b*; and, through the pivot, the screw passes which holds the cock firm in its place, and also attaches the lock to the stock of the gun in the back-action lock (see fig. 6*), but, in the bar-lock, by the usual tumbler pin or nut. The action of the lock is produced by the union of the main and sear-springs in one piece,—which spring, at the end *c*¹, is provided with a semicircular piece, in place of a tumbler; and the concave side of the part *c*¹, is notched, to catch the tooth of a projecting sear *a*¹, fixed on to the inner side of the cock *a*,—the sear *a*¹, passing through the curved slotted opening *b*¹, in the plate *b*, to take into the notched part *c*¹, of the spring when the hammer is placed at half or whole cock; and the part *c*¹, has a stud *c*², which projects at right angles from it into the stock, to be struck or pressed by the action of the trigger, to set the cock at liberty. The sear-piece *a*¹, is rounded at its lower end, and traverses in the curved opening *b*¹, in the plate *b*, when placing the hammer on half or whole cock; and the curved ends of the opening *b*¹, limit the action of the cock in either direction. The stud *c*³, fixed to, and

forming part of, the spring *c*, passes through the slotted opening *b*², in the plate *b*, and takes into a recess *a*², on the inner surface of the cock; and, when the cock is pulled back, the recess *a*², acting on the stud *a*³, compresses the spring. On the sear *a*¹, being released by the trigger depressing the stud *c*³, a rapid motion will be given to the cock or hammer by the stud *c*³.

Fig. 7, shews, in side view, a safety-bolt or catch, for bolting the cock or hammer, and preventing guns from being discharged by accident. Fig. 8, is a plan of the same parts; and figs. 9, and 10, shew a side and plan view of the hammer and cock-plate, with the safety-catch applied thereto.

On the circular part *a*, of the cock or hammer, are formed notches or ratchet-teeth *d*, into which the bent end of the lever or ball-bit *e*, takes, and retains the hammer at half or whole cock until released in the following manner. The lever *e*, is attached to, and carried by, a pin or axis *f*, which passes through the lock-plate into the bridle-leg. On the axis *f*, is fixed a second or inner sear *g*, the bent arm, *g*¹, of which is lifted or depressed by the lever *h*, carried by a projection *h*¹, on the inner-surface of the trigger-plate. *j*, is the grip-lever, one end being attached by a pin-point to the projection *h*¹, the other resting on the end of the slot in the trigger-plate. *i*, is a spring, screwed to the inner surface of the trigger-plate, one end of the spring always pressing the arm of the lever *h*, in contact with the lever *g*¹, so as to keep the lever arm *e*, in connection with the ratchet-teeth on the hammer (the other end of the lever resting upon the grip-lever *j*, which is constantly pressed outwards by the spring *i*); and the other end of the spring *i*, acting on the trigger to keep it in position. The lever *h*, has a spring *h*², affixed to it, as shewn; and when the grip-lever is pressed upwards, the end of the spring *h*², depresses the arm *g*¹, and removes the lever *e*, from the notches on the hammer when at half or full cock; but when the cock is resting or depending on the safety-catch, any accidental blow or pressure on the grip-lever is received on the spring *h*²; thereby preventing any injury or derangement of the safety apparatus.

Fig. 11, shews a plan of a gun arranged according to the fourth part of the invention. Near the breech end of the barrel a mortice or opening is formed, through which the chamber or moveable breech turns horizontally upon a vertical axis. By this arrangement the upper part of the barrel is continued along the upper part of the stock, and forms a plate, to which it is affixed; and the metal at the breech is cut

away, as shewn, to receive the moveable breech; the barrel being enlarged for that purpose. *a*, is the fixed part of the barrel of the gun, and *b*, the moveable breech, turning with the pin *e*, to which the trigger-plate is attached, and capable of turning at right angles with the gun, as shewn by dotted lines, so as to place the end of the moveable breech in a position to be loaded. *d*, is a bolt, for retaining the breech in a right line with the barrel when loaded.

Fig. 12, is a longitudinal section, and fig. 13, a cross section of a pistol constructed according to the fifth part of the invention; and fig. 14, is an end view of the revolving-breech. *a*, is the tube or barrel, of any suitable length, and open at each end; the upper part being continued at *a'*, descends at right angles, returns, rises again, and joins the under-side of the barrel, forming a rectangular opening, in which the series of chambers containing the several charges revolve, so as to be successively brought opposite to the barrel *a*, and discharged, as hereinafter explained. The revolving-chambers *b*, are supported by and revolve on the axis *b'*, which slides in a groove on the under-side of the barrel, through the rectangular frame *a*; the end being supported in the back part of the frame, which is solid with the barrel, as shewn; and the series of revolving-chambers may be readily detached from the opening through the frame by drawing the axis *b*, out towards the mouth of the barrel; or the series of revolving-chambers may be supported on two conical centres, one or both of which may be capable of sliding out, so as to detach the series of chambers, as shewn in section at fig. 15. The back of each chamber is recessed, as shewn, to receive the nipple *b²*; and at the end are formed ratchet-teeth *b³*, into which the perpendicular ratchet-lever *c²*, (shewn detached at figs. 16,) works; the other end being connected to the trigger *c*, by the pin *c³*, which forms an axis for the sear *c¹*, that takes into a bend or recess *e¹*, formed in the front part of the cock or hammer *e*. When the trigger is pulled back, the sear *c¹*, lifts the hammer to a sufficient height for the main spring to drive it forward and effect the explosion of the cap: the sear *c¹*, is thrown out of the recess *e¹*, by the projecting nib or tooth on the cock, when the cock is forced back to the fullest extent. The hammer strikes the cap in a horizontal direction; the striking part passing through a hole formed in the hinder part of the frame *a'*. A spring-bolt *d*, when pressed inwards, comes against a shoulder on the hammer-head, and keeps it back, to prevent the hammer discharging the cap by an accidental blow, or for safety in carrying, or when disengaging the part *b*.

f^1 , is a spring, to return the trigger and parts attached, to their original position; c^4 , is a stud on the trigger, which enters recesses on the outer circumference of the revolving-breech, at the time each chamber is brought opposite to the barrel a , and retains it there whilst the discharge takes place.

The patentee claims, First,—the constructing the interior of rifle-barrels with ridges; also, the manufacture of barrels with internal projections for the powder to pass into, and for the ball to fit on. Secondly,—the improvements, herein described, of gun and pistol locks. Thirdly,—the improvements, herein described, in safety-bolts or catches of fire-arms. Fourthly,—the improvements, herein described, in guns and other fire-arms arranged to load at the breech. And, Fifthly,—the mode of constructing the breech end of a barrel to receive a revolving series of chambers; and also the arrangement or combination of locks for such description of fire-arms.—[Inrolled August, 1851.]

To WILLIAM DICKINSON, of Blackburn, in the county of Lancaster, machine-maker, and ROBERT WILLAN, of the same place, mechanic, for certain improvements in machinery or apparatus for manufacturing textile fabrics.—[Sealed 17th July, 1851.]

THIS invention relates to improvements in looms, and consists, first, in an improvement in the stop-motion; by means of which, the ordinary stop-rod and frog are dispensed with, and the severe concussion that takes place when these parts come into contact, in the act of stopping the loom, is entirely prevented. Secondly, it consists in an improvement in the arrangement of the reed, whereby it is rendered both fast and loose,—that is to say, it is quite firm whilst the slay beats up, provided the shuttle has entered the shuttle-box, but it becomes loose if the shuttle is caught in the shed; and thus the breakage of the warp-threads is avoided, the loom is made capable of weaving fabrics of any required strength, and it may be driven at a much greater speed than those of the ordinary construction. Thirdly, the invention includes an improved mode of easing or relieving the pressure of the shuttle against the swell in the shuttle-box during the operation of weaving.

In Plate V., fig. 1, exhibits so much of a loom as is necessary to be shewn, in order to explain this invention. a , is the slay or lathe; b , the slay-cap; and c , the reed, the top

and bottom bars of which enter recesses in the slay and slay-cap, but are not fixed thereto. *d*, is a horizontal spindle, which is supported by bearings affixed to the under side of the slay, and is capable of turning therein. To this spindle, at the right-hand end (which is shewn in the drawing), are fixed three arms or levers *e, f, g*; and, to the other end thereof, are fixed two arms, corresponding to those marked *e, f*. The arms *e*, project backward in a horizontal direction, and support two vertical rods *h*, which are capable of sliding in sockets or brackets, cast on the slay-swords, and are attached, at the top, to the slay-cap *b*; so that, if the arms *e*, move upwards, the slay-cap will be lifted. To each of the vertical arms *f*, is bolted a spring *i*, which presses against the swell *j*, and causes the same to project into the interior of the shuttle-box when the shuttle is absent therefrom. *g*, is an arm with a bevilled end, which, when the slay beats up the weft, either passes over or under an angular bar or stud *k*, fixed to the frame, and acting as a substitute for the ordinary frog. *l*, is a spring-rod, which shifts the driving-strap from the fast to the loose pulley.

When the loom is working correctly, the shuttle, at each traverse, enters the shuttle-box, and pushes back the swell *j*, in opposition to its spring, which is thereby caused to turn the spindle *d*, just sufficient to raise the outer end of the arm *g*, to a proper height for passing over the angular stud *k*, on the slay beating up the weft. But, when the shuttle fails to enter its box, motion is not imparted to the spindle *d*, by the spring, and the end of the arm *g*, remains in such a position that, on the slay beating up, it will come in contact with the inclined side of the stud *k*, and pass beneath it; by this depression of the end of the arm *g*, the spindle *d*, is caused to turn partly round in the reverse direction, and, through the medium of the arms *e*, and rods *h*, to raise the slay-cap, so as to permit the reed to fall back on the warp-threads into the position indicated by the dotted lines *c**; and, as the slay continues to advance, the end of the arm *g*, comes in contact with a bent piece of metal *m*, affixed to the spring-rod *l*, and causes such rod to spring from the catch or notch whereby it is ordinarily held, and, by shifting the driving-strap from the fast to the loose pulley, to stop the loom.

Fig. 2, exhibits a modification of the preceding arrangement, in which the reed is released from the slay-cap by permitting it to descend therefrom, in place of raising the slay-cap. In this case, the reed rests upon a horizontal bar *n*, supported, at each end, by a vertical rod *o*, carried by an arm

*g**, from the spindle *d*. The slay-cap *b*, is a fixture, instead of being moveable, as in the arrangement shewn at fig. 1. When the shuttle does not enter its box, the spring *i*, permits the arms *g**, to descend, and thereby to lower the bar *a*, and withdraw the top bar of the reed from the recess in the slay-cap; and, as the slay moves forward, in the act of beating up, the reed will fall back into the position indicated by the dotted lines *c**.

The patentees do not confine themselves to the exact details above given. They claim, Firstly,—the new arrangement of the stop-motion. Secondly,—the fast and loose reed. And, Thirdly,—the method of relieving the pressure against the swell in the shuttle-box, as above described.—[Inrolled January, 1852.]

To HENRI and ALEXANDRE SIX, of Wazemmes le Lille, temporary of Paris, France, Gentlemen, for improvements in bleaching flax and hemp.—[Sealed 24th March, 1851.]

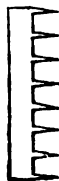
THE improvements in bleaching flax and hemp, which constitute this invention, consist in certain means of bleaching, firstly, the fibrous parts of flax and hemp in the straw (i.e. before being peeled); secondly, flax that has been only partially peeled, so as to leave a certain portion of straw, which is peeled off after the bleaching; and, thirdly, flax that has been completely peeled and brought to the state of fibre or combed before being spun.

The patentees state that they employ a continuous system, which consists in subjecting flax and hemp in the straw, when placed in the vats, to all the chemical operations usually employed for obtaining the different degrees of whiteness, without changing the position of the same until the completion of the bleaching process. The flax is placed in the vat upon a false bottom, disposed in a suitable manner for being raised by means of a crane, pulley, or other suitable apparatus. The flax may be agitated in the vats or withdrawn therefrom, according as it may be deemed expedient.

Secondly, the patentees apply the bleaching processes to flax which is partially divested of its straw: in this case, the straw is allowed to remain on to the height of about eight inches at the foot of the plant, and the peeling is completed after the bleaching operation. It is stated that this mode of operating preserves the flax in a more natural and more advantageous condition, and that the same will form less tow in

combing than flax which has been completely peeled previous to bleaching.

Thirdly, the patentees use hurdles for bleaching flax, either partially or completely peeled, or after being combed. The form and dimensions of the hurdles vary according to the vats in which the bleaching is performed; and they may be constructed of wood, metal, or any other material. They are composed of an assemblage of laths, made in the form of combs (as represented by the diagram), and placed at from $1\frac{1}{4}$ to 2 inches apart. The teeth thereof are from 1 to 2 inches high, about $\frac{1}{4}$ an inch in diameter at the base, and taper gradually to a point: they serve to produce apertures in the layers of flax, and facilitate the filtration through the same of the bleaching liquors. The flax is deposited in layers, varying in thickness, upon the hurdles, which are placed one upon the other in the bleaching vats until the latter are full. Each hurdle is supported by the teeth or points of the hurdle next below it; and by this means the flax is left free between the various hurdles, so that the pressure of those at the top does not prevent the bleaching agents from penetrating with as much facility through the matters at the bottom of the vat as through those which are above. The same result may be obtained by using hurdles without teeth, made of wicker-work or wood, and placing a small cross-piece between the adjacent hurdles, so as to prevent the upper ones from pressing upon the flax placed on those below. When the last-mentioned hurdles are used, rods, about a quarter of an inch in diameter, must be introduced through the flax, to facilitate the filtration of the liquids through the same.



It is stated that one of the advantages resulting from the different modes of bleaching above described consists in obtaining the flax, after bleaching, in such natural and perfect condition that it may be spun as easily as if it had only been submitted to a steeping operation. The flax, after being bleached according to this invention, will produce a stronger and more beautiful thread than that which is bleached after being spun in the raw state.

The vats, used in carrying out this invention, are provided with a perforated false bottom, fixed at a height of from four to eight inches above the ordinary bottom; and, between the two bottoms, a steam-pipe is introduced, in order to raise the temperature of the solution contained in the vat, if required. When operating upon the flax in sheaves (*i. e.*, in the straw),

the bundles or sheaves are placed in an upright position upon the false bottom of the vat ; but, if the flax has been partly or completely peeled or combed, it is spread and worked upon hurdles. The lye, chlorine, acids, and water, are successively introduced into the vat in sufficient quantities to cover the flax ; and they are drawn off, after having produced the desired effect, by a tap at the bottom of the vat.

The patentees state, that they consider it unnecessary to describe the chemical processes employed in bleaching, because all the known means may be applied to obtain the object of their invention with equal advantage. They do not confine themselves to the details above given with regard to dimensions and forms ; nor do they claim the different parts of the apparatus before described, taken separately. They claim, First,—the application of a continuous series of operations for bleaching the fibrous parts of flax and hemp direct and simultaneously in the same vat, and without changing their primitive position, either in the straw (that is to say, before peeling), after they have been partially or entirely divested of the straw, or after being combed, as hereinbefore described. Secondly,—the application of the bleaching processes to flax which has been peeled at the upper part of the plant,—the straw being left, to a certain extent, at the lower part, as hereinbefore described. Thirdly,—the application of hurdles, when operating upon flax that has undergone the operations of peeling and combing, as hereinbefore described and shewn in the drawing. Fourthly,—the application of rods, to facilitate the filtration of the bleaching agents through the matters to be bleached, as hereinbefore described.—[*Inrolled September, 1851.*]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in portable bedsteads, and in sacking-bottoms,—being a communication.—[Sealed 4th March, 1851.]

THIS invention relates, first, to a novel mode of constructing portable bedsteads, whereby they may be folded up and packed in a small compass for facility of conveyance ; and, secondly, to an improved mode of making and attaching the sacking-bottoms to bedsteads.

The improved bedstead consists of a series of upright posts, made either of wood or metal, and connected together by ar-

rangements of levers, constructed on the well known lazy-tongs principle, and adapted in such a manner, that the uprights may always be retained in a vertical position, and be firmly braced together. The several parts are so constructed and arranged, that the bedstead does not require to be taken to pieces, in order to be folded up and packed; and it occupies so little space, that the bedstead, sacking, blankets, sheets, and everything connected therewith, can, with facility, be packed in a small trunk or portmanteau.

In Plate VI., fig. 1, represents a side view of the bedstead, folded up and packed with the sheets, blankets, and sacking, in a portmanteau,—the portmanteau being in section; fig. 2, is a plan view of the bedstead, extended, with the improved sacking adapted thereto, ready for use; fig. 3, is a longitudinal or side elevation; and fig. 4, is an end elevation of the same. *a, a, a*, are the corner posts, which are, in this instance, made of metal tubes; and *b, b*, are short vertical side posts, which are preferred to be made of iron or brass tubes. These posts *b*, are connected together longitudinally by a series of levers *c, c, c*, which are jointed together at their centres at *d, d, d*;—their lower ends are jointed at *e, e, e*, to the lower end of the vertical posts *b, b*, and corner posts *a, a*; while their upper ends are secured to the sliding rings *f, f*, which, not being fixed to the posts *a, a*, and *b, b*, are left free to move up and down thereon. The posts *a, a*, and *b, b*, on both sides of the bedstead, are connected together transversely by another series of levers *g, g, g*, fig. 4, which are attached or jointed to the same parts of the posts *a, a*, and *b, b*, as the levers *c, c*, but at right angles thereto,—that is, the lower ends of the levers *g, g*, are secured to the fixed rings *e, e*, at the lower ends of the posts; and the upper ends of the levers *g, g*, are jointed to the sliding rings *f, f*, so that all the levers must act simultaneously. The corner posts *a, a*, are tubular, as before mentioned, and contain other tubes *h*, and *i*, as shewn best in the enlarged sectional view fig. 5. It is preferred to make these tubes fluted or corrugated, in order that they may possess greater strength, and for the purpose of preventing them from turning round in each other; and, when the middle tube *h*, is drawn up, it is held in the elevated position shewn in the drawings by the spring-catch *j*. At the upper part of this tube *h*, there is a ring, hook, or other fastening *k*, for the purpose of supporting the head part of the sacking, as shewn at figs. 3, and 4. A third tube *i*, is enclosed within the tube *h*, and, when drawn up, is retained in its elevated position by a spring-catch *k*. From the upper

end of these tubes or rods *i, i*, curtains or mosquito nets may be supported, if required, as shewn by the dotted lines at figs. 3, and 4.

The improvement in the sacking consists in inserting gores, gussets, or pieces *m, m, m*, in certain parts thereof, for the purpose of making hollows for the reception of certain projecting parts of the body, such as the shoulders, hips, knees, &c. The sacking is furnished, at each corner, and at other places along the sides, as at *n, n*, with hooks, whereby it is supported from the corner and side posts, as shewn at figs. 2, 3, and 4. It will be seen at fig. 3, that the head part of the sacking is raised up, so as to support the head of the person reposing thereon in a comfortable position, without the use of a pillow or bolster.

The patentee claims, First,—making the frame of a portable bedstead of a series of vertical posts, connected and combined together by an arrangement of levers, constructed on the principle of the lacy-tongs, which will admit of the bedstead being closed up into a small space when required. Secondly,—suspending the sacking-bed, made of canvas, or other suitable material, by means of hooks, rings, or other fastenings, secured to the sides or edges thereof; and inserting in such sacking, gores, gussets, or pieces, whereby it may be made to fit the swell of the body at the shoulders, hips, knees, and other parts, as above described.—[Inrolled September, 1851.]

To JAMES TIMMINS CHANCE, of Birmingham, Gent., for improvements in the manufacture of glass,—being a communication.—[Sealed 28th July, 1851.]

THIS invention consists, firstly, in an improved mode of employing more than one flattening stone or bed with the same flattening kiln, when manufacturing sheets or plates of glass,—attempts having heretofore been made to effect this object, by placing such stones or beds upon a connected base or framework, common to two or more of them; or by causing one stone or bed to pass directly over or under the other, in effecting an interchange. Secondly, the invention consists in an improved implement for lifting and transferring sheets or plates of glass in the processes connected with the flattening kiln and annealing arch or chamber.

In Plate VI., fig. 1, is a vertical section and fig. 2, a sectional plan view of a flattening kiln and annealing arch. *a*, is a traversing frame or carriage, on the top of which are fixed

two sets of rails *b*; the gauge whereof coincides with that of the rails *c*, fixed in the flattening place; and the carriage is moved to and fro upon the rails *a*, as required, by means of the arrangement of levers *e*. *f, f'*, are two flattening stones or beds, one of which, *f*, (see fig. 2,) is in the flattening place, and the other, *f'*, is upon the right-hand set of rails *b*, of the traversing frame. The mode of working with this flattening kiln is as follows:—Supposing the unoccupied set of rails *b*, to coincide with the rails *c*, (as shewn at fig. 2,) the workman, having finished the sheet or plate of glass on the flattening bed *f*, pushes that bed out of the flattening place on to the rails *b*, of the traversing frame. The assistant now moves the traversing frame in the direction of the arrow; and when the other set of rails *b*, that carry the bed *f'*, coincide with the rails *c*, the workman pulls the bed *f'*, into the flattening place, and proceeds to work upon it. At a convenient time, he lifts the sheet or plate of glass from the bed *f*, and deposits it either in the annealing arch upon or in a suitable receptacle *g*, or on another bed, according to the arrangements of the kiln. The flattening beds may, in this manner, be regularly interchanged.

The patentee prefers that the flattening beds should have a flanged guide-wheel *h*, on each axle thereof, to run upon a central guide-rail *i*, instead of the wheels that support the beds being made with flanges; as any slight inaccuracy of coincidence between the gauge of the rails *b*, and *c*, is thereby rendered unimportant. The traversing frame might move on wheels supported by stationary bearings, instead of having wheels connected to it; or a revolving frame might be substituted for the traversing one, by modifying the arrangement of the adjacent parts of the kiln.

Fig. 3, is an edge view, and fig. 4, an under-side view of an improved fork or implement for lifting and transferring sheets or plates of glass. The prongs of this implement are furnished with small rollers *j*, the spindles of which are carried by small ears or lugs on the under side of the prongs, and the rollers project slightly above the upper surface of the prongs.

The patentee does not confine himself to details. He claims, First,—the employing, in connection with the same flattening kiln, more than one flattening stone or bed, not connected together by a common supporting base or framework, and in such manner that two flattening stones or beds can be interchanged without one of them having to pass directly over or under the other. Secondly,—the combining rollers with the implements used for lifting and transferring sheets or plates of glass, as aforesaid.—[Inrolled January, 1852.]

To JAMES CHEETHAM, jun., of Chadderton, near Oldham, in the county of Lancaster, cotton manufacturer, for his invention of certain improvements in the manufacture of bleached, colored, or party-colored threads or yarns.—
[Sealed 24th March, 1851.]

THIS invention consists in the production of bleached, colored, or party-colored cotton yarns, by submitting the material to the action of bleaching or coloring when in a preparation state, subsequent to the operation of carding. In order to avoid the imperfection incidental to bleaching or coloring spun yarns, and also to dispense with certain operations in the course of manufacture, attempts have been made to bleach and color cotton in its raw state, or before the completion of the carding process. It has, however, been found that such a course was productive of much waste, without effecting a perfect diffusion of the bleaching or coloring matter. According to this invention, the material is submitted to the bleaching, dyeing, or printing process, when in the form of a regular sliver, whereby the liability to waste is prevented: its spongy nature and regular disposition of fibre also afford a condition favorable to the permeation of the chemical matters employed.

In the manufacture of party-colored yarns, the patentee states that, in addition to gaining a superiority of color, he is enabled to dispense with the ordinary operation of doubling; for, by combining any desired number of slivers or slubbings, of various colors, a party-colored yarn may be produced therefrom at one operation of spinning. The following is the mode of proceeding:—The cotton is first prepared in the usual manner, until it has passed the drawing operation. It is then carried to a slubbing-frame, of ordinary construction, but so modified in its relative speeds as to effect rather more twist than is required for the usual subsequent operations; the design being to gain a sufficient firmness to admit of the bleaching, dyeing, or printing process, without the risk of stretching or breaking the continuity of fibre. The slubbings, thus prepared, are reeled, after the manner usually adopted for dyeing, printing, or bleaching spun yarns. It will generally be found advisable, however, to reel the slubbings two or more together, but without twisting; for by this arrangement there will be less liability to breakage, the end will be more easily found when broken, and the winding altogether facilitated. The material may now be subjected to any of the ordinary operations, whereby spun yarns are bleached, dyed, printed, or otherwise colored. The wringing-out, as ordina-

rily practised in the souring or washing of spun yarns, would however be likely to break the continuity of sliver or slubbing, and therefore it is preferred to use the "hydro-extractor" for dispelling the moisture. The slivers, thus bleached, dyed, or printed, having been previously consolidated by more than an ordinary amount of twist, are at present unfit—by reason of their solidity—for the usual drawing operation of the roving machine; they are therefore submitted to a process by which the superabundant twisting is removed, and their former softness restored. This is effected (when using ordinary cotton machinery) by winding the slivers into cans or on to bobbins, and conducting them between the front rollers only of a slubbing frame,—the flyers thereof being caused to revolve in a direction the reverse of that which previously effected the twist. By this treatment the twist may be removed to any amount, regulated by the number of revolutions, or the velocity may be such as to remove it entirely, and effect the desired amount of torsion in the other direction.

If machinery be used which is designed solely for the improved manufacture, it will be obvious that, as no drawing is at this stage required, one pair of rollers only are necessary. The bleached, dyed, or printed slubbings, having been thus produced, may be worked into rovings and spun into yarn, after the usual manner, in ordinary machines. In producing party-colored yarns, the inventor proceeds in the manner above described, until the material has been bleached, dyed, or printed, and passed through a slubbing machine, without drawing, in order to remove the superabundant twist. He then takes a number of the slubbings, according to the combination of colors required; and, by repeating the operations of drawing and doubling, brings them into one roving, suitable for being spun into yarn which shall be of the required party-color. Suppose, for instance, eight slubbings, of different colors or shades, were run through a third slubbing-frame, four at a time, with a draft of four, they would be resolved into two slubbings, which, worked into a roving, and subsequently spun, would constitute a yarn composed of eight colors or shades—a less or greater variety being in like manner effected. As another example,—if a thread of any count be wanted composed of one-fifth green and four-fifths purple, with a draft of five—four prepared slubbings of purple and one of green, run together, would produce slubbings of the required hue, which, being worked together in the roving-frame, and finally spun, would make the desired yarn—the ordinary operation of doubling being dispensed with. In-

stead of the invention being applied to the material after it has passed through a slubbing process, it may be carried into effect previously to that stage of the manufacture: that is to say, at any time after the last carding has been effected. It is also stated, that, if desired, slubbings or rovings of cotton, in the ordinary grey state, and also wool, silk, or other fibrous materials, may be combined with other slubbings, bleached, dyed, or printed, according to the improvements, and be incorporated therewith, so as to be suited for the final operation of spinning. The patentee claims the bleaching, and also dyeing, printing, or otherwise coloring cotton, between the process of carding and that of spinning.—[Inrolled September, 1851.]

To THOMAS EARL OF DUNDONALD, Admiral in Her Majesty's Navy, of Chesterfield-street, in the county of Middlesex, for improvements in the construction and manufacture of sewers, drains, water-ways, pipes, reservoirs, and receptacles for liquids or solids, and for the making of columns, pillars, capitals, pedestals, vases, and other useful and ornamental objects, from a substance never heretofore employed for such manufacture.—[Sealed 22nd July, 1851.]

THIS invention consists in the use of bitumen, petroleum, or natural pitch of Trinidad, and of the British North American colonies, for manufacturing the above-named and other useful and ornamental objects. This material is of various qualities—some descriptions being more or less indurated, and others being of a more soft or even fluid consistence. Therefore, the bitumen is selected according to the nature of the article which it is desired to produce: thus, if the articles are to be firm and possess great strength, a bitumen possessing those qualities (such as the indurated bitumen of Trinidad) is chosen; and for articles which are to be more or less flexible, a bitumen of a corresponding character (such as is found in the pitch or bitumen lake of Trinidad) is selected. The qualities of the material may likewise be varied by blending two or more different descriptions of bitumen together.

When pipes, and similar articles, which must be capable of resisting considerable internal pressure, are to be made, the selected or prepared bitumen must not only be hard, but possess considerable tenacity: much of the indurated Trinidad bitumen is of this description. The pipes are preferred to be

cast in open moulds, and with one side flat, as represented in transverse section at fig. 1, Plate VI. Within the mould (*a*, fig. 2,) is placed a core (*b*,) corresponding in size with the required internal diameter of the pipe; and the mould and core are coated with clay, black lead, or any other material which will prevent the melted bitumen from adhering to the same. The bitumen is then melted and poured into the mould. The flat side causes the pipe to stand firmly in the position in which it may be laid; but, if desired, the pipes may be cast cylindrical, or of any other shape. Lengths of these pipes may be united by simply interposing a heated plate of metal to produce semi-liquefaction of the surfaces, or by directing a hot blast or jet of flame thereon, and then pressing the parts together; or the same may be joined by the use of liquid or melted bitumen.

Plates, sheets, or tables of bitumen, may be made by first casting a suitable quantity of the material in the shape of a block, and then passing it, whilst soft, between rollers, until it is reduced to the desired thickness: during this operation, the rollers must be kept warm by steam, or other agent; and clay, black-lead, steam, or hot water, must be applied to the peripheries of the rollers, to prevent the adherence of the bitumen. Plates, sheets, or tables, thus produced, may be used to line water cisterns or reservoirs, and also to form floors or impermeable coverings for excluding damp, and for other purposes. The edges of the sheets are united by applying heat, or a solution of bitumen. Heat may be applied by means of an iron resembling a soldering iron; and, when requisite, some of the bitumen, in small pieces or powder, may be introduced between the edges, and melted. If a solution of bitumen is to be used, the bitumen may be dissolved in naphtha, and brought to a pasty consistence. The sheets or plates may be cut into long strips, and formed into pipes by bending them transversely round a core (as exhibited by the transverse section, fig. 3), whilst in a soft or plastic state, and then uniting the edges by the means just described. Pillars, pedestals, capitals, ornamental fittings, and other articles, may be made of bitumen, by casting in moulds, and either solid or hollow, or with a piece of some other material (such as wood or iron) to strengthen them, or to reduce the amount of bitumen employed.

Thin and flexible sheets of bitumen, prepared as above described, may be strengthened by having cloth pressed against and thus united to them; and such sheets may also be made double, having cloth or other texture placed between two thin

sheets of bitumen, and the whole united by rolling or pressure. The cloth is preferred to be of a light, open texture, and made of hemp, or any other cheap material; and the cloth is, by preference, prepared by impregnating it with a small portion of a solution of bitumen, or liquid bitumen, so as to cause it to adhere more readily to the sheets of bitumen. The sheets of bitumen intended to be thus combined with cloth, should be warmed sufficiently to make their surfaces adhesive; and the surfaces of the rollers or press should be treated as above described, to prevent the adherence of the bitumen thereto. Pieces of cloth may also be coated with bitumen on both sides, by applying a solution of bitumen to the same by a brush, or other means. Amongst other uses, such combinations of bitumen and cloth may be applied for covering ships' bottoms, between the hull of the vessel and the metallic sheathing.

The patentee also employs the bituminous material to cover, and thus insulate, the conducting wires of electric telegraphs which are intended to be placed under ground. For this purpose, bitumen of a flexible description is used, and, when in a melted state, the wire is conducted through it; then the wire is caused to pass through some die or orifice, to remove the superfluous bitumen; and, after this, it is passed through water, or, preferably, through a mixture of water and clay, or water and lime, so as to deprive the surface of the bitumen of its adhesive qualities, and cool it. The wire, thus coated, may be wound on a reel, or otherwise coiled, in readiness for use; and, in hot weather, it may be desirable to do this under water. The coating upon the wire will be more uniform if the latter be previously covered with some cheap filamentous material; and the saturation of the filamentous material by the bitumen will be much facilitated by first passing the covered wire through naphtha, or fluid bitumen, or a solution of bitumen. The incasement of the wire with bitumen may also be effected by covering it with a fibrous material, which has been previously saturated with melted bitumen, and then passing the covered wire through a heated die or orifice, so as to melt or soften the bitumen, and press the coating against the wire,—thereby forming a compact continuous covering.

Figs. 4, 5, and 6, exhibit another mode of covering wires, which is particularly applicable in cases where it may be desired to lay down several such wires. *c*, is a core of hempen rope, or other suitable material, to which a thick covering *d*, of flexible bitumen is applied: it may be put on the core in

the manner above described for covering wires with bitumen. Small longitudinal grooves *e*, are produced on the surface of the bitumen by corresponding projections in a heated die or collar, through which the core *c*, with its covering, is drawn; then, along these grooves, the wires *f*, are laid; and finally, the whole is covered with longitudinal strips of bitumen, *g*, in the same manner as explained with respect to fig. 3, for making pipes. The ends of these bituminous cases may be joined by the methods described for uniting lengths of pipes.

It is likewise proposed to apply the bitumen or petroleum to coating the bottoms of iron ships, or other metallic bodies which are subject to galvanic influences, or to destruction by corrosion. The bitumen or petroleum is dissolved in a sufficient quantity of its natural naphtha, and applied in a hot state, by a brush or otherwise, to the ship's bottom, or other metallic body.

In carrying out the above objects, the patentee takes advantage of the properties of the best descriptions of bitumen; but he also points out the application to various uses (as hereafter described) of the crude and less pure material, which constitutes the greatest portion of the natural bitumen before mentioned. Supposing it be desired to construct sewers, drains, or water-ways, and that the trench or ditch *h*, fig. 7, is formed to receive the structure destined to construct the fluids—into such trench or ditch a quantity of gravel, stones, or similar materials *i*, is thrown; and then crude bitumen, in a molten state, is poured thereon, so as to form the same into concrete. This operation of throwing in gravel, and pouring in melted bitumen, may be continued until the space between *j*, and *k*, at the sides of the trench, is filled; and a core, mould, or form (indicated by the dotted circle *l*,) may be used to regulate the internal dimensions of the sewer or water-way. Or the parts of the structure may be cast in lengths, of such forms as will fit together, and produce the desired construction of sewer, drain, or water-way, or portions thereof; and the blocks, or parts, may be united together by running in melted bitumen between the joints, or by using bitumen in its natural plastic state.

It is also proposed to employ the crude bitumen for constructing submerged foundations for marine works, by pouring it in a boiling state, combined with gravel, stones, or such like materials (constituting a bituminous concrete) into the water over the site of the intended foundation, as at *m*, fig. 8. It is stated that if the bottom is of a soft nature, and the concrete is continuously poured thereon, the successive por-

tions will firmly unite with those previously deposited, and form one block of any magnitude or strength necessary for the superstructure, as represented at *n*, fig. 9. Such crude bitumen or bituminous concrete is used in like manner to support decayed or undermined piers, pillars, or walls, as exhibited at *o*, fig. 10, and for other purposes, such as arresting and consolidating rolling gravel or shifting sand, and for forming embankments.

Lastly, the patentee says, "I effect an object, by the application of crude bitumen, which is highly conducive to the interests of the British tropical colonies, namely, by forming channels watertight, or nearly so, for enabling the copious streams from the mountains—which hitherto have run to waste or been absorbed in the beds of the streams—to be conducted to the places where their fertilizing effects may be beneficially applied. For this purpose, I render the beds of the streams watertight, or nearly so, by means of a coating of bitumen *s, s*, fig. 11, which (in localities destitute of other means for melting) may be strewed in the channels and fused by burning brushwood or other combustibles laid amongst or upon it."—[*Inrolled January*, 1852.]

To HARDING HALLEN, of Burslem, in the county of Stafford, manufacturer, for improvements in gas-burners.—[Scaled 10th May, 1851.]

THIS invention consists in constructing gas-burners of a combination of metal and pot or fire-clay, or other clay composed of any mixture of potters' materials—the outer part of the burner being made of metal, and that part in which the holes are pierced for the passage of gas being made of clay, and therefore better calculated to resist the action of the flame, and the corrosive effects of the products of combustion, which quickly destroy gas-burners composed wholly of metal.

In Plate VI., fig. 1, is a vertical section of a fish-tail burner, constructed according to this invention. *a*, is a metal tube, through which the gas ascends to the exit openings; and *b*, is a button of clay (shewn in plan view at fig. 2,) with holes pierced in it for the escape of the gas. Fig. 2, is a vertical section of an argand burner, all of which is made of metal except the perforated ring *c*, (shewn in plan view at fig. 4,) which is fire-clay. The buttons and rings are formed in moulds when the clay is in a plastic state; they are then dried and burned to the required degree of hardness; and

after this they are fixed in their places either by cement only, or by applying cement and burnishing down the edge of the metal upon the upper surface of the clay. The patentee says it will be obvious that a great many varieties if not all kinds of gas-burners may be formed in the manner just explained for forming fish-tail and argand gas burners: that is to say, by the insertion of perforated buttons, rings, or pieces of pot or fire-clay into that part of the burner through which the gas issues.

He claims the constructing of gas burners of a combination of metal and pot or fire-clay, or other clay composed of any mixture of potters' materials, as above described.—[*Inrolled November, 1851.*]

To ALFRED VINCENT NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for an improved composition, applicable to the coating of wood, metals, plaster, and other substances, which are required to be preserved from decay; which composition may be also employed as a pigment or paint,—being a communication.—[Sealed 19th November, 1850.]

THE object of this invention is to prepare a chemical composition, suitable for coating wood, metals, plaster, and other like substances, and preserving them from decay. For this purpose, a mixture, containing the following materials, may be prepared, either by the employment of natural products, or of suitable metallurgical refuse:—

Metallic zinc	14 parts by weight.
Metallic iron	1 "
Oxide of zinc	869 "
Oxide of iron	273 "
Silicic acid	70 "
Argil	3 "
Charcoal	47 "
Carbonate of zinc	223 "
	1000

These substances are first reduced to a very fine powder, and are afterwards ground up with raw fixed oil (poppy and linseed oil, by preference, in the proportions of two parts of linseed oil to one of poppy oil). The composition, thus prepared, is used in the same manner as ordinary oil-paint,—it being, however, first diluted with a mixture of two parts of raw fixed oil, and one part of essence of turpentine, or more, if required.

It is said that two coats of this composition (over which any other paint may be afterwards laid) will be sufficient to protect the surface of damp walls from the effects of the weather; and it will not be liable to crack or scale off. The composition is equally applicable to stone, plaster, wood, metals, &c.; and may, therefore, be advantageously employed for buildings of all kinds, ships, stockades, piers, jetties, sleepers for railways, turnpike and other gates, bridges, and other large works of public utility.

When stone walls, plaster, or cement, are to be operated upon, they must first be well scraped, and freed from all previous paint, and well soaked with a mixture of one part of sulphuric acid, at 66°, to five parts of water. This liquor must be applied until effervescence ceases. The surface is then left to dry, and three coats of the composition are to be laid on,—care being taken to let each coat dry before applying the next coat.

In cases where the surface is very damp, or impregnated with saltpetre, it will be found advantageous to add to the composition, above mentioned, from eight to ten per cent. of proto-sulphuret of antimony.

The patentee gives the following formula (which are modifications of the improved composition) as the best results of numerous experiments recently carried on by the inventor:—

No. I.—First extraordinary coating.

Oxide of zinc	137 parts.
Peroxide of iron	77 "
Silica	236 "
Alumina	30 "
Charcoal	159 "
Metallic iron	59 "
Metallic zinc	2 "
Peroxide of manganese	300 "
	1000

No. II.—First ordinary coating.

Oxide of zinc	170 parts.
Metallic zinc	2 "
Peroxide of iron	218 "
Metallic iron	1 "
Silica ..	219 "
Alumina	29 "
Charcoal	111 "
Peroxide of manganese	250 "
	1000

No. III.—*Second and third ordinary coatings.*

Oxide of zinc	215 parts.
Peroxide of iron	202 "
Silica	275 "
Alumina	31 "
Charcoal	124 "
Metallic iron	1 "
Metallic zinc	2 "
Peroxide of manganese	150 "
	1000

No. IV.—*Third black coating.*

Oxide of zinc	132 parts.
Peroxide of iron	108 "
Metallic zinc	2 "
Metallic iron	49 "
Silica	305 "
Alumina	26 "
Charcoal	233 "
Peroxide of manganese	150 "
	1000

No. V.—*Third light coating.*

Oxide of zinc	287 parts.
Peroxide of iron	409 "
Silica	231 "
Alumina	23 "
Peroxide of manganese	30 "
Metallic iron	19 "
Charcoal	1 "
	1000

The substances forming these combinations must be ground down, and diluted with the proportions of oil and essence of turpentine above mentioned. In certain cases, it may be advisable to employ the following coating or mastic, in order to fill up joints, holes, or flaws, &c.; or it may be used to coat the entire surface to a thickness of from $\frac{1}{10}$ th to $\frac{1}{3}$ rd of an inch in depth :—

Carbonate of lime	450 parts.
Silica	87 "
Charcoal	88 "
Metallic iron	47 "
Alumina	20 "
Metallic zinc	1 "
Oxide of zinc	37 "
Peroxide of iron	25 "
Peroxide of manganese	250 "
	1000

These substances are to be reduced to a fine powder, well mixed, and ground to a suitable consistence in a mixture of three parts of linseed oil and one part of hempseed oil.

The patentee claims, First,—the manufacture of the composition above described, under any and all its modifications, and its application as a pigment, or as a coating, to preserve wood, metals, plaster, and other substances from decay. And particularly, he claims the use, in such composition, of silica, or silicic acid, or of silica in some one or more of its combinations,—the presence of which substance is an essential element in the improved composition. And further, he claims the use of proto-sulphuret of antimony, in the manner and for the purpose above explained.— [*Inrolled May, 1851.*]

To JOHN WORKMAN, of Stamford-hill, in the County of Middlesex, fumist and furnace builder, for improvements in the manufacture of bricks, tiles, and other articles made of like materials.—[Sealed 31st July, 1851.]

THIS invention consists in a method of making bricks, tiles, and other porous articles made of like materials, non-absorbent or waterproof.

The apparatus employed in carrying out this invention is represented, in longitudinal vertical section, in Plate VI. The bricks or other articles *a*, having been previously subjected to the process of burning, are placed upon the moving endless chain *b*, and are thereby conducted into the hot air chamber *A*, which is heated by a suitable furnace *c*, capable of raising the temperature to upwards of 500° Fahr. The bricks or other articles are thence carried downwards by the endless chain to the part *B*, of the apparatus, which forms a receptacle for a solution composed of whale or seal oil and sugar of lead, in the proportion of a quarter of an ounce of the latter, in a pounded state, to each gallon of oil: the solution is supplied from a cistern *d*, above; and the supply is regulated by means of the float *e*, connected by rods and levers *f*, with the valve *g*, which closes the passage *h*, that connects the cistern with the receptacle *B*. The heated bricks, or other articles, are thoroughly immersed in the solution; they are then caused to pass through the hot chamber *c*, in order to harden the solution; and, finally, they pass from the endless chain on to the inclined plane *i*, from which they are to be removed for stacking. After this operation, the bricks or other articles should be subjected to the action of the atmosphere

for about fourteen days. For bricks, tiles, or other articles used to face houses and other buildings that are exposed only to the dampness of the atmosphere and rain, and are not always in contact with water (as is the case with those used for wharfs or river walls), linseed oil is preferred to be used instead of whale or seal oil; and the heat of the chamber *A*, in this case, may be below 500° Fahr.

The endless chain *b*, consists of two sets of links, made of angle or T iron, hinged or jointed together. The two sets of links are kept equidistant from each other by horizontal cross rods; across the top of the two sets cross pieces or plates of metal are fixed, which carry the bricks or other articles; and these cross pieces or plates are furnished with vertical rods, which stand on each side of the bricks, and serve to keep them in their proper positions upon the chain. The endless chain passes over an hexagonal drum *j*, at each end of the apparatus, and is supported in its course by numerous small rollers *k*. It may be put in motion by any convenient means. The top of the furnace is covered with fire tiles or plate iron: either of which may have a layer of sand above, to prevent the heat from passing off too freely.—[*Inrolled January, 1852.*]

To JOHN CHATTERTON, of Birmingham, agent, for certain improvements in protecting insulated electro-telegraphic wires, and in the methods and machinery used for the purpose.—[Sealed 12th June, 1851.]

THIS invention relates to the protection of electro-telegraphic wires which are insulated by a coating of gutta-percha or similar material. The patentee remarks that iron-wire rope has been wound around the gutta-percha covering, but that it is open to the objection of the probability of air and water finding their way between the strands of the rope. It has been also proposed to enclose the gutta-percha in leaden tubing; but it is essential that the metal should be in close and uniform contact with the gutta-percha; and this can only be effectually accomplished by drawing the tubing, while in course of formation, or as fast as formed, over the gutta-percha covering; whereas the metal, when forced from the machine in the ordinary process of making such tubing, is at so high a temperature that it would injure the gutta-percha. This difficulty is overcome by the present invention, which consists in an improved arrangement of machinery, whereby leaden tubing is, as fast as it is produced, so lowered in tem-

perature, as to be brought over the gutta-percha covering without injuring the same.

A plan view of the improved arrangement of machinery is shewn in Plate VI., *a*, represents the delivery-end of an hydraulic lead pipe-making machine of the ordinary description; *b*, is the framework that carries the additional parts employed in effecting the object of this invention; *c*, is the gutta-percha covered wire, which is to be protected by the leaden tubing, and is supported by the rollers *d*; *e*, is the end of the core or mandril whereon the tubing is formed; *f*, is a thin wire that connects the wire *c*, with the core *e*, and is supported by the rollers *g*; *h*, is a trough through which a stream of cold water is kept constantly flowing, and wherein a portion of the wire *f*, is immersed; and *i*, is a wooden drum, the spindle of which rests and turns in open bearings, so that it may be readily lifted therefrom, and it is driven by wheel-work *j*, from the spindle *k*, which is put in motion by turning the handle *l*.

The following is the mode of working with this apparatus: As the leaden tubing is forced off the core *e*, by hydraulic pressure, it passes along the wire *f*, through the water-trough *h*, and thence onwards to the gutta-percha covered wire *c*: by which time it will be so cooled down that it will not injure the gutta-percha on being brought into contact therewith. A chain or cord being connected to the leaden tube, it is thereby conducted over the wire *c*; and when any desired length of wire has been thus covered with the tubing, it is cut off, and passed through a die or between grooved rollers, placed at *m*, whereby the lead is firmly pressed into contact with the gutta-percha; and from the die or rollers the protected wire is conducted to and wound upon the drum *i*.

In order to unite two lengths of wire which have been thus protected, the lead and gutta-percha are cut away, at the ends to be joined, for about two inches, so as to leave that length of copper wire bare; the two exposed ends of wire are next twisted and soldered together; after which, they receive a covering of gutta-percha, of the same size or diameter as the leaden tubing; and then a socket or coupling joint, about five inches long, is slipped over the ends of the two lengths, and soldered to the leaden tubing by means of a blow-pipe or copper bit,—a quickly fusible alloy being used for this purpose. The instant that the joining is completed, cold water is thrown over it, to prevent the gutta-percha being injured by the heat.

In place of passing the leaden tubing through the water-

through *h*, as before mentioned, it may be exposed, during its passage along the wire *f*, to a current of cold air; but the former plan of cooling is preferred. Instead, also, of the leaden tubing being drawn over the covered wire as described, the covered wire may be drawn through the tubing, by first drawing the tubing to the desired length over a plain wire, to the end of which the covered wire is attached, and then pulling out such plain wire, and consequently causing the covered wire to occupy its place in the tube. When two or more wires are to be enclosed in one tube, each wire is insulated with gutta-percha, or similar material, independently; and then they are twisted together so as to form a rope, which is then covered with leaden tubing in the same manner as a single wire.

The patentee claims the protecting of electro-telegraphic wires, when insulated by a coating of gutta-percha or other analogous material, by lead or other metal tubing, passed or drawn over the same, according to the methods and by means of the machinery before described: that is to say, in so far as regards the passing of the tubing, as it is formed, over plain wire, attached to the end of the core; the lowering of the temperature of the tubing before bringing it into contact with the gutta-percha insulated wire; and the final compressing of the whole together by dies or grooved rolls.—*[Inrolled December, 1851.]*

To HENRY GLYNN, of *Bruton-street, Berkeley-square, Gent.*, and RUDOLPH APPEL, of *Gerrard-street, Soho, anastatic printer, for improvements in the manufacture or treatment of paper or fabrics to prevent copies or impressions being taken of any writing or printing thereon.*—*[Sealed 14th August, 1851.]*

THE patentees remark that it is well known that by means of recent discoveries a facsimile of an original printed document, however elaborately engraved or designed, can be produced in a very short time from the paper impression itself; and any person moderately acquainted with lithographic and zincographic printing can obtain any number of exact copies without the aid of an artist or engraver. Now this invention consists in so manufacturing or treating paper or fabrics as to prevent a transfer or reproduction of any bank note, bond, bill of exchange, cheque, engraving, writing, lithograph, or other document or print being made by a transferring process.

For the above purpose, the paper or fabric is imbued or impregnated with materials which will prevent a transfer,—which materials will either be acted on chemically by the surface or materials used to produce a transfer, or will impart to the paper or fabric such a protective quality as will prevent a successful transfer. The following is the method of carrying out the invention which the patentees believe to be the best:—A solution of a salt of copper (by preference, a nitrate or sulphate) is mixed with the pulp of which the paper is to be made; and then an alkali or alkaline salt (phosphate of soda being preferred) is added, in order to produce a cupreous precipitate (either hydrated oxide of copper or a salt of copper) until reddened litmus paper turns blue on testing it therewith: one ounce of nitrate of copper, or its equivalent of sulphate of copper, is sufficient for two gallons of pulp; and less may be used if the color is found objectionable. After this, the pulp is to be carefully washed with water, and then made into paper. The patentees mix with an alkali as much fixed oil (not a drying oil) as it will convert into soap, and heat the same until thoroughly melted; and, while in a state of ebullition, they add old palm oil, and heat until thoroughly incorporated;—or they prepare a mixture of equal parts of white soft soap and old palm oil. A quantity of the soapy mixture is dissolved in boiling water, in the proportion of half a pound of the mixture to each gallon of water; and into this solution the paper, which has been impregnated with copper when in the state of pulp, is dipped. The paper is then sized in the usual way; or the size, without alum, might be mixed with the soap solution, previous to immersing the paper in it; or the soap solution might be combined with the pulp when the same has been impregnated with copper. When the destruction of the original document is not desired, and it is only sought to prevent a transfer being taken, then the soap solution may be used alone without the copper; and it may be mixed with the pulp of which paper is to be made; or unsized paper may be dipped in it, and afterwards sized; or it may be mixed with the size without alum.

In order to prevent a transfer being taken from paper or fabric made in the usual way, the same is to be soaked or otherwise impregnated with a saturated solution of sulphate of copper, or its equivalent of nitrate, or other soluble salt of copper; when dry, it is to be dipped into a solution of alkali or alkaline salt (by preference, phosphate of soda), sufficiently strong to convert the soluble salt of copper into an insoluble one; after which it is to be carefully washed in water, dried, and then dipped in the soap solution.

D'Urcle's, for Increasing the Produce of Autumn Wheat. 199

The patentees state, that they do not confine themselves to the salts of copper above mentioned, as other salts, having a similar effect, may be used, but, as they believe, with not so good a result,—such, for instance, as salts of lead or other metals, and which chemists well know to be capable of effecting the object above described: that is, such as will be acted on chemically by the surface or materials employed to produce a transferred impression from a document.—[*Inrolled February, 1852.*]

To FELIX CHARLES VICTOR LEON LIEVACHER D'URCLE, of Paris, France, farmer, for improvements for increasing the produce of autumn wheat.—[Sealed 12th June, 1851.]

THE patentee commences his specification by stating, that, up to this time, autumn wheat has been wrongly treated, on the supposition that it is an annual plant; whereas, he has discovered, by study and repeated experiments, that autumn wheat is, by nature, essentially and positively biennial, like beet-roots, carrots, &c. Now, his invention consists in developing the biennial properties of autumn wheat by a peculiar plan of planting and treating the same, by which the produce will be considerably increased.

The mode of carrying out this invention is as follows:—The ground, on which it is proposed to sow the grain, should be tilled and well manured, either before the winter, or at the beginning of the spring, so as to be ready to receive the wheat between the 20th of April and the 10th of May, and not before. The patentee prefers this period for sowing, because if that operation takes place sooner, there is a chance of the plant being in blossom the same year, which cannot be the case when the sowing is performed during the period referred to, and therefore the plant really becomes biennial. The period of sowing may however be advanced in course of time and from year to year; for, if it were not for the present degeneracy of the plant, the sowing might take place now at the beginning of March. Each grain of wheat must be sown separately, and must occupy a surface the extent of which will be smaller in proportion as the ground is poorer in condition, and larger as the ground is better manured and the wheat in a less degenerate state. The wheat is planted in rows of holes, formed at regular distances apart (between the extremes of $9\frac{1}{4}$ inches and $23\frac{1}{4}$ inches) in each direction;—the holes of each succeeding row

will never putrefy, but become exsiccated and dried like a mummy, without the least indication of decomposition. Thus the "sirocco," or dry wind, which blows in the sandy deserts of Africa, is found to preserve animal matter for ages, even in that high temperature; and Dr. Shaw tells us, that "at Saibah, which lieth about the half way betwixt Ras Sem and Egypt, there are a number of men, asses, and camels, which have been preserved, from time immemorial, in this manner." They are supposed to have belonged to some caravan, which, in passing over these sandy deserts, was destroyed or suffocated by the sirocco. To this class also belong the mummied relics lately discovered in South America, and which are presumed to be the bodies of ancient Peruvians, similarly suffocated in attempting to cross the burning deserts of their country when invaded by the legions of Pizarro.

Another source of preservative power is found in the absence of heat, or what is called cold. Without heat none of the phenomena of fermentation can go on; thus the acetous fermentation requires a temperature of 70° or 80° Fahr., and ceases at 50°; the alcoholic requires from 60° to 70°, and ceases at 40°; whilst the putrefactive is most active about 100°, and becomes imperceptible at 36°. On this account, meat which is frozen, or at a temperature of 32°, will keep for any length of time. Thus the celebrated traveller Pallas mentions the fact, that the carcase of a rhinoceros (an animal essentially of a warm climate) was found on the banks of a river that falls into the Lena, below Jacutsk, in Siberia. This carcase was, at first, quite entire, and, indeed, many of the muscles and tendons were actually adhering to the head when Pallas received it. The preservation of this animal, says Professor Playfair, was, no doubt, owing to its burial in earth perpetually in a state of congelation; for the place is in the 64th° parallel of latitude, where the ground is never thawed, but to a small depth beneath the surface. But a still more remarkable example of this description of preservation was discovered in the same region about the year 1799. This was the body of an enormous animal found imbedded in a block of ice upwards of 200 feet high. When first noticed, this animal was about 40 feet beneath the surface, and, as the ice gradually thawed away, the carcase became exposed. The hair, skin, and flesh, when first disclosed, were in such good preservation, that dogs, and other animals, devoured them, and preyed for weeks upon the body. According, however, to Cuvier, by whom this animal has been examined, it differs from every species of the elephant now known, as well as from

the bones of the large animals discovered in America; nor has it any resemblance to any animal now existing on the face of the globe. Cuvier, therefore, considers it as antediluvian; and, in his opinion, it has been preserved from the period of the deluge in the mass of ice which enveloped it. The same principle is practically applied in Russia at this day; and veal, frozen in Archangel, is a common commodity in the markets of St. Petersburg; from whence has been derived the custom of freezing the Scotch and Irish salmon, which is now sent to London in such perfect preservation. Nor must it be forgotten, that Bacon, the father of modern philosophy, caught cold and lost his life in an experiment of "stuffing a fowl with snow, to preserve it, which answered remarkably well," according to the statement of this great enquirer into the mysteries of nature. It is, therefore, perfectly certain that, by a low temperature, the putrefactive process may be prevented or arrested for an indefinite period; and nothing but the impossibility of securing the above condition interferes with the practical application of this plan. There is, however, a circumstance connected with the after treatment of these frozen provisions which deserves mention, and that is, the rapidity with which, when thawed, they begin to decompose. This is a serious inconvenience in the case of salmon; but may be almost entirely prevented by attention to the mode in which they are thawed. From what we have before said concerning the action of dew and distilled water, it is clear that, if any substance, when frozen, be exposed to warm air, the moisture of the air will be deposited on the frozen body in the state of dew, exactly as happens when a bottle of iced water is brought into a warm room. But this moisture contains the element of decomposition; and, therefore, the moment that the frozen body has thawed, and its temperature risen a little, the putrefactive fermentation sets in with the greatest possible vigour; and, in two hours, a week's work of damage may be effected. To remedy this inconvenience, fish, or other frozen provisions, should be placed in cold water, to which a little salt has been added, and there retained until the process of thawing is complete; when they may be exposed and treated like fresh articles of the same description.

Thus far our remarks have been applied solely to raw or uncooked meats; but the practical bearing of the object which we have in hand really points to those which are, more or less, cooked and preserved. It is with reference to provisions of this kind that a parliamentary enquiry is now in progress;

and we cannot do better than shew the great importance of the subject to a maritime nation like Great Britain, by stating, that these provisions, when sound, are an absolute preventive of sea-scurvy,—a disease said, on good authority, to have destroyed more life, and to have done more damage to our navy, than all the enemies and tempests which that navy ever encountered. We need not go far in search of evidence to prove the fearful havoc caused by this disease; for we are well furnished by the history of Admiral Anson's memorable expedition to damage the interests of Spain in the Pacific Ocean, by intercepting the annual treasure ship or galleon on her return to Europe. In spite of everything that care and experience could do, Anson tells us that he lost, in all, fully four-fifths of his people by scurvy. Of *four hundred men*, with whom the Centurion departed from England, only two hundred lived to reach the island of Juan Fernandez, and *no more than eight* of these were capable of doing duty; and but for a supply of others at St. Helena, there would not have been strength remaining to carry the ship to her anchorage. After describing, in the most pathetic manner, the dreadful sufferings of his crew, and rejoicing at the improvement caused by the sojourn at Juan Fernandez, the writer concludes,—“I therefore shall sum up the total of our loss since our departure from England, the better to convey some idea of our past sufferings and our present strength. We had buried, on board the Centurion, since leaving St. Helena, two hundred and ninety-two men, and had remaining on board two hundred and fourteen. This will, doubtless, appear a most extraordinary mortality; but yet, on board the Gloucester (his other ship of war) it had been much greater; for, out of a much smaller crew than ours, they had buried the same number, and had only eighty-two remaining alive. It might,” continues Anson, “have been expected that, on board the Tryal (a provision ship), the slaughter would have been most terrible; but it happened otherwise, for she escaped more favorably than the rest, since she *only* buried forty-two, and had now thirty-nine remaining.” The real object of the voyage was, however, not yet commenced; though, out of 961 men, with which the three vessels left England, 626 were dead before this time.

It is almost superfluous to multiply instances of the same kind; though, in order to demonstrate the great utility of preserved meats in the navy, we shall give two or three other examples, as there is evidently a desire, in certain quarters, to get rid of a trifling labor and responsibility, by excluding

this class of provisions altogether from our victualling departments. In October, 1788, the fleet of Admiral Keppell came into harbour, and, before the end of December, had sent 3,600 sick to the hospital at Haslar. In 1779, the channel fleet, under Sir C. Hardy, sent 2,500 to the hospital, and retained more than 1000 on board for want of hospital accommodation. Within four months, during a subsequent year, 6,064 were sent to Haslar; and Sir Richard Hawkins asserts, that, within the space of twenty years, to his own knowledge, not less than 10,000 men had died of scurvy. When Admiral Geary's fleet returned to Portsmouth, after a ten weeks' cruise in the Bay of Biscay, 2,400 men were ill of the scurvy; and the gross number of admissions into the hospital that year was 11,732, of whom 909 died. Now, the highest medical authorities in this kingdom, and also on the continent, have all expressed the opinion, that this fearful disease and mortality is altogether caused by the use of salt provisions; and the evidence of a host of navy surgeons and officers can be adduced to corroborate the truth of this view: therefore, not only motives of humanity, but also of self-interest, imperatively demand that, wherever unsalted provisions can be used, their employment should be insisted on, by the voice of the entire nation. Such being the case, it becomes necessary for us to enquire how far the art of preserving unsalted provisions has reached that degree of uniformity, and certainty of result, which alone can warrant their introduction into the navy.

The first successful attempt at the preservation of unsalted meats is of French origin, and due to the inventive skill of M. Appert. This gentleman, so long ago as the year 1810, received from the Board of Arts and Manufactures of Paris the sum of 12,000 francs for his discovery of a mode of preserving animal and vegetable substances; the results of which had been then amply attested, by a prolonged experience in the French navy. Shortly after this period, Appert induced a Mr. Durant to visit London, for the purpose of taking out a patent; and this was accordingly done towards the end of the year 1811. In this patent, however, the claims were ridiculously wide, so much so, that the patent right was subsequently infringed with impunity. The claims included all kinds of fruit, meat, and vegetables, when subjected to the action of heat in closed vessels, more or less freed from air. As, however, the Society of Arts, in London, had presented, in 1807, a premium to a Mr. T. Saddington, for "a method of preserving fruit without sugar for house or sea-stores"—which method is exactly the same as that of M. Appert—the

validity of Durant's patent was at once called in question. Nevertheless, so satisfactory were the results, when applied to animal food, or mixed provisions, that the patent was eventually purchased from Durant by Messrs. Donkin, Hall, and Gamble, for the sum of £1,000; and the firm, thus established, became at once the sole manufacturers of preserved meats in this country. The process of Appert was, however, extremely defective in a manufacturing point of view. Nothing but glass bottles were to be used for containing the meats; and M. Appert remarks,—“I choose glass for this purpose, as being the most impenetrable to air, and have not ventured to make any experiment with a vessel made of any other substance.” Of course the fragility of this material, and the great difficulty of hermetically sealing the bottles with corks, threw an incalculable impediment in the way of the process as a commercial undertaking. Nor was it until after a long series of difficult and expensive experiments that Messrs. Donkin, Hall, and Gamble were able to overcome the primary difficulties of this invention, and produce provisions successfully preserved in tin vessels. Since that time but little alteration, and less improvement, has been made in the art, the principles of which are far more complex than has hitherto been supposed.

From the researches of M. Gaylussac, it appeared that the absence of oxygen was requisite to prevent fermentation; but it is now certain, that oxygen may be present with fermentable matters without producing any effect whatever. As there are substances and conditions which cause or accelerate fermentation, so there are others which prevent or retard it; and this is true, whatever be the nature of the fermentation. Although, therefore, the exclusion of oxygen be a means of preventing putrefaction, it is not the only means, nor is it, indeed, the easiest or simplest in application. The process of Appert certainly does not depend upon the exclusion of oxygen from the provisions he preserved, nor is this principle included in the improved process still practised, with such marked success, by the well-known firm of Gamble, at Cork. We have had an opportunity of examining the air contained in perfectly sound canisters of Gamble's provisions, and have constantly found it to afford distinct evidences of the presence of oxygen gas, even in cases several years old. The quantity is, indeed, much less than that in atmospheric air, but its existence is clear and undeniable. Hence we must look for some other theory than that which refers putrefaction to the presence of uncombined oxygen, if we wish to speculate upon

the *modus operandi* of Gamble's method. Appert seems to have had a decided doubt as to the sufficiency of the oxygen theory, for he tells us that "fire has a peculiar property, not only of changing the combination of the constituent parts of vegetable and animal productions, but also of retarding, for many years at least, if not of destroying altogether, the natural tendency of these same products to decomposition." And this opinion is confirmed by many startling facts, which cannot be reconciled to the supposition that oxygen is the sole or even principal agent of decomposition. Thus milk, which has been merely scalded, will keep much longer from the effect of this process, even though freely exposed to, or purposely impregnated with, oxygen gas. All kinds of meat exhibit a similar result. Again, very minute quantities of some mineral substances, as arsenic and corrosive sublimate, or of organic matters, such as creosote, naphtha, and the volatile oils, have the same action when applied to meat or vegetables; and, generally speaking, anything which will coagulate albumen has a preservative power upon organic substances. So that oxygen appears to exert a decomposing force only when one or other of the forms of soluble albumen is present. Now, the method of Appert, as improved by Gamble (for the firm of Donkin, Hall, and Gamble no longer exists), is to render the albumen of the meat or vegetable insoluble, and therefore scarcely, if at all, susceptible of the action of atmospheric oxygen. By this means the total exclusion of air from the tin cases is rendered unnecessary, for even if a small quantity of air remains in the case, it will exert no more influence than happens to a piece of coagulated albumen, or hard-boiled white of egg, which, as is well known, may be exposed to the air for years without sensible alteration, though, in its uncoagulated state, it immediately putrefies. If, therefore, we were desired, in a few words, to express the essential characteristics of Gamble's process, it would not be by referring to the exclusion of air, but to the thorough coagulation of the albumen, that we should look for a satisfactory description. In this process the meat, more or less cooked, is placed, with a quantity of gravy, in a tin vessel, capable of being hermetically sealed with solder; it is then heated, for some time, in a bath of muriate of lime, and the aperture neatly soldered up. After this it is again exposed to the action of the heated bath for a period, which varies with the size and nature of the contents of the vessel; and to prove that this latter operation is really the most important of the whole, it sometimes happens that cases which have begun to

decompose are opened, resoldered, and again submitted to the muriate of lime bath, with the most perfect success, as regards the ultimate result. There is, however, no little difficulty in effecting the thorough coagulation of albumen by heat, when the quantity of albumen is small in proportion to the water present. A long continued and rather high temperature is then needed; more especially if vinegar or lactic acid be present in the fluid, as these tend to retain the albumen in solution: much must therefore depend upon practical experience; and it is not improbable that a heat in the bath but little higher than that of boiling water, would afford more uniform results than can be obtained with a boiling saturated solution of muriate of lime. This subject will, however, be more fully discussed when speaking of Goldner's process.

Although by no means free from occasional failures, and certainly requiring improvement, the system of Gamble has, in practice, worked well; and provisions have been kept, in this way, for a period of more than twenty-six years, without the slightest alteration in their peculiar qualities. And so well is this fact known and appreciated by British naval officers in general, that few vessels now leave our ports without at least a proper supply for cabin use. It was found by Sir John Ross that a number of cases of these preserved provisions, left for many years upon Fury beach, and exposed to excessive variations of temperature, were, nevertheless, perfectly sound and wholesome as food when opened.

Guided, probably, by theoretical considerations, and too much impressed with the necessity of excluding oxygen, a Mr. Goldner, some few years ago, adopted the idea, originally conceived by Sir Humphrey Davy, of enclosing cooked provisions in a complete vacuum. For this purpose the provisions, slightly cooked on the surface, were enclosed in canisters, similar to those of Gamble, but stronger, and provided with a small opening in the cover. These canisters were then subjected to the heat of a bath, or otherwise rapidly heated, until steam, of a very high tension, issued from the opening in the cover. At this moment a slight condensation was effected by the application of a cold and damp rag or sponge, and simultaneously with this the small opening was soldered up. In theory, nothing could seem better adapted to insure success; but, from the late parliamentary disclosures, it is evident that the practical working of the invention affords any thing but a satisfactory result. Nor is there much difficulty in conceiving how this may arise, as, in the first place,

the application of a sudden high heat to non-conducting materials, is almost certain to give rise to that peculiar condition of water called the spheroidal state, and by which the interior of the meat will be as thoroughly protected from the effect of heat as if no heat were applied. Hence, even though steam, in abundance, may issue from the small opening in the cover, this is no proof that the meat in the centre of the vessel is even warm; and still less does it warrant the supposition that the soluble albumen is thoroughly coagulated; and, without which, as we have stated, preservation is scarcely possible. But, in addition to this, the application of a damp rag, in the way described, is, of all others, that by which a portion of air is most likely to be drawn into the vessel at the very moment when its total expulsion is taken for granted; and both these circumstances are more liable to happen with large than with small canisters. If, however, the meat has been but partially cooked, in consequence of the water in it assuming the spheroidal condition, and, at the same time, atmospheric oxygen is included, there can be no manner of doubt that putrefaction will occur, and run its course with the same rapidity as if no process whatever had been employed to prevent it. That water so situated in the substance of flesh is extremely prone to take on the form called spheroidal, needs no other proof than that the human hand may be deliberately passed through molten brass or iron with perfect impunity, and without even sensibly warming of the fingers, as illustrated by M. Boutigny. It is not, therefore, enough to expose these canisters of provisions to heat, unless that heat be so gradually applied as to prevent the assumption of a spheroidal state by the watery portion of the food; and we cannot help thinking, that much of the disappointment and loss, consequent upon this kind of manufacture, has its origin in a want of attention to the above circumstance. Where all power of circulation is prevented, as in the instance of these semi-solid meats, the tendency of the part in immediate contact with the source of heat to acquire a temperature capable of inducing the spheroidal condition, must be very great indeed; and hence, in speaking of the muriate of lime bath, employed by Gamble, we took occasion to hint, that more uniform results might perhaps be obtained by a moderate than by a high temperature. The probability is, that no advantage is gained by exceeding 220° of Fahr.; and, viewing the subject chemically, even this seems too high, where time is less an object than perfection of manufacture.

It now remains only to offer a few remarks on the cooking of animal food, and its application to the wants of humanity. If flesh be digested for a short time in cold water or brine, it parts with several of its most important constituents; and therefore the practice of large and repeated washing is an unwise and extra-fastidious operation. Cold water dissolves from meat its soluble phosphates, its lactic acid, its kreatine, and kreatinine, as well as its albumen. Without these constituents, however, the meat neither is, nor can be, fitted to supply the muscular wear and tear of the human frame. In fact, one of these substances (kreatine) has evidently a singular connection with muscular energy, as it exists in greatest quantity in the flesh of animals most remarkable for muscular power and activity. To exclude it, therefore, is to introduce an element of weakness in the dietary of our seamen, that cannot fail, in the long-run, to shew itself; and hence the enormous prostration of strength which accompanies the seascurvy; for it happens that, as kreatine is soluble in brine, but little of this valuable element remains in the contracted and solidified mass known by the name of salt-junk, and employed as food in the navy upon much the same principle as that ascribed to alligators, who swallow stones to appease the cravings of an empty stomach. If, however, there is an error in the commencement of our navy victualling, there is a still greater in the treatment of salt-junk by its prejudiced and ill-informed consumers. Having had its albumen and other valuable matters removed by a cold solution of common salt, the junk is next deprived of its gelatine and osmazome, by the action of boiling water; and this gelatine, which, with the kreatine and lactic acid, would greatly facilitate the process of digestion, is thrown away as worthless; and nothing but a hard mass of fibrine, scarcely if at all susceptible of assimilation by the powers of the animal economy, remains to give the appearance of food to the product, and, as it were, "keep the word of promise to the eye, to break it to the hope." The following quotation from "*Liebig's Researches on the Chemistry of Food*," may fitly occupy a place here: "It is obvious, that if flesh employed as food is again to become flesh in the body—if it is to retain the power of reproducing itself in its original condition—none of the constituents of raw flesh ought to be withdrawn from it during its preparation for food. If its composition be altered in any way—if one of the constituents which belong essentially to its constitution be removed—a corresponding variation must take place in the power of that piece of flesh to reassume, in the

living body, the original form and quality on which its properties in the living organism depend. It follows from this, that boiled flesh, when eaten *without* the soup formed in boiling it,—is so much the *less* adapted for nutrition the greater the quantity of the water in which it has been boiled, and the longer the duration of the boiling.”

Under such circumstances, we cannot wonder that, in spite of the acknowledged purity of sea air, disease to a large extent should prevail in our navy, and that when any active malady makes its appearance, the mortality should greatly exceed that of the army under similar circumstances. This is a mere natural sequence of the system pursued with regard to provisions; and, so far from abandoning altogether the employment of preserved meats from the casual putrefaction of a few cases, it seems to us that a wise government would rather seek to remedy this inconvenience, by calling in the aid of science, than fall back into a supine condition, when the interest of the nation so loudly calls for activity. After all, however, we can find no proof that these preserved provisions have failed, except in the case of Goldner; for there are many other manufacturers, both in this country and in France, whose productions no more warrant the ban of exclusion, than a trifling accident deserves to be deemed a deliberate crime. If failure be a sufficient reason for interdicting further operations, how shall we account for the persevering assiduity of our dockyard authorities in respect to ship-building? We sincerely hope that the parliamentary committee, now sitting, will not separate until the whole subject of preserved provisions has been fully and impartially investigated in all its details.

INSTITUTION OF CIVIL ENGINEERS.

January 27th, 1852.

THE discussion was renewed on the *alluvial formations and the local changes of the South-Eastern Coast of England*, by Mr. J. B. REDMAN, M. Inst. C.E., and many of the views stated by the author in the paper were still further argued. It was stated, that the formation of such points as Dungeness and Langley were always found to windward of the outfall of a river, which, in the former case, passed through a clay district, bringing down much deposit, forming an accretion, or delta, in the low shallow water at the outfall. This was thought to be a more natural explanation of such phenomena, than to assign them to the mere force or action of the waves, or the tidal currents—causes which

must have been in operation, unchanged, for ages; and it was asserted, that it was physically impossible for any tidal currents which existed in the channel, to have had much to do with their formation. A shallow shelving coast was also thought to be favorable to the formation of these points; and Selsea Bill was instanced as a case in which this accretion was actually in a state of progression, whereas Dungeness and Langley might be supposed to be nearly completed. Other speakers argued, that these formations took place on clay deposits, whether they simply formed the coast line, or were protruded beyond it, and that the Shambles shoal was formed on a nucleus of rock, with a superficial covering of shells.

The depth at which shingle would travel under water was considered to be a very important point in this question, as on it really depended the right principles for executing many engineering works. From actual experience, it had been observed, that it did not travel at a greater depth than from two fathoms to three fathoms; so that when a natural headland, or an artificial work (as a pier or groyne), was projected into that depth of water, the passage of shingle round it was arrested.

Some difference of opinion appeared to exist, as to the position of the largest pebbles on a cross section of these banks. On the one hand it was asserted, that they were invariably found to have attained the greatest altitude; that this was the case in the Hurst, Langley, and other beaches to the Eastward; and that it might be attributed to the force of the approaching wave being greater than that of the receding one, so that large pebbles brought up by the former would be left, whilst the smaller ones would be clawed away by the reflux. On the other hand, the Chesil Bank was cited as an instance to the contrary, where the smallest pebbles were stated by some authorities to be on the top. Both parties, however, agreed that the largest pebbles were always to be found at the leeward point of the formation.

With regard to the action of the meeting of the tides in the Channel, as shewn by the charts of Captain Beechey, it should be observed, that the point of junction and parting oscillated over a sea-board of nearly sixty miles, and therefore its action would be over a corresponding latitude, and thus it could exercise but little influence in isolated cases.

A paper was then read, entitled *a description of a cast iron viaduct erected at Manchester, forming part of the joint station of the London and North Western, and Manchester, Sheffield, and Lincolnshire railways*, by Mr. A. S. Jee, M. Inst., C.E.

The object of this structure was to obtain increased accommodation for the goods station of the two companies, which was formed on brick arches, at a level of about 30 feet above the adjacent streets,—the arches themselves being used as goods ware-

houses, and the communication between the two levels being effected by means of hoists. This extension was 700 feet long and 36 feet wide; and as it was necessary that it should cover, without interfering with, the lines of way on the low level, a row of Doric columns, of cast iron, surmounted by an entablature forming the enclosure of the station, was arranged, each about 20 feet apart from centre to centre, on the outer boundary of the space to be occupied, and on these one end of a transverse cast iron girder was placed, the other end being supported by the brick arching. To the transverse girders, longitudinal cast iron girders, one to each rail, were attached, and to these half balks of Memel timber were bolted,—the whole being planked with 3-inch deals, on which three lines of way, and an ample supply of turn-tables for working the traffic, were laid.

To effect a communication between this station and a warehouse belonging to the Sheffield Company, Store-street had to be crossed, which was done by means of wrought-iron girders, 68 feet clear span, of peculiar construction. The top part of these girders consisted of a cylindrical tube, 2 feet in diameter, made of boiler plate, half inch thick; the middle web was 3 feet 6 inches in depth, and formed of plates 5-16ths of an inch thick; the bottom flange was 20 inches in width, and at the centre was composed of three plates, each $\frac{3}{4}$ ths of an inch thick, diminished to one plate at the ends. These girders were each tested with a weight of 60 tons at the centre, when the deflection was not found to exceed one inch.

The whole of the cast iron work was of Stirling's toughened iron, by which a saving in weight of about one fourth of the quantity that would have been necessary with ordinary iron was effected, without any diminution in the absolute strength. Messrs. Robinson and Russell were the contractors, and they had most satisfactorily performed the work, the total cost of which, including twenty-one turn-tables, was under 14,000*l.*, or about 20*l.* per lineal foot.

February 3rd, 1852.

The discussion on Mr. Jee's paper on *the cast iron viaduct erected at Manchester, forming part of the joint station of the London and North Western, and Manchester, Sheffield, and Lincolnshire railways*, occupied the entire evening.

Mr. Hawkshaw remarked that a nearly similar structure had been erected at Salford, in 1842, forming a junction between the Liverpool and Manchester, the Manchester and Leeds, and Manchester and Bolton railways. In this structure, the columns were placed in pairs, and, instead of planking between the transverse girders, flat brick arches, set in cement, were introduced. Some interesting experiments on the strength of the girders were given, and the ingenious steelyard lever testing machine was described.

The question then turned upon the peculiar form of the wrought-iron girder bridge over Store-street, and on the manner in which the experiments had been made for ascertaining its strength. From minute calculations, which were given, it appeared that this bridge was, foot for foot, as strong and stiff as wrought iron, cellular-top, tubular girders of the ordinary form; and though, in this instance, the size of the cylindrical top, which was required to be large enough to admit a man for painting the inside, and for necessary repairs, might seem disproportioned to the depth of the girder, yet this would not be the case if the span and depth of the girder was increased, as the cylindrical top might still remain of the same size. By some speakers, however, it was contended, that in applying wrought iron to girders of comparatively small span, there really was no necessity, nor was it advisable, either as regarded strength or convenience, to adopt the cellular form; but that the girder should be of the ordinary, simple, double T section, with the bottom flange and the middle web of wrought iron, and the upper flange either of wrought or of cast iron,—the latter being the best suited for resisting the compressive strain to which that part of a girder was subjected; and it was thought that both of these forms would be a more economical application of material for girders of limited extent than cellular tops. A modification of these different plans was described to consist in a kind of flattened triangular top, of which the base was uppermost, and the plates were thickest, representing the upper flange of the ordinary girder,—the two sides being merely thin plates, to prevent the edges of the upper flange from buckling under the compressive strains.

Doubts were also raised as to whether painting was the best mode of protecting wrought iron from oxidation; and it was suggested, as an improvement, that the iron should, in the first instance, be thoroughly cleaned and plunged at a low heat in common oil, and then dried. An alloy of cast iron, containing a small portion of tin, was also said to prevent, effectually, the injurious effects of oxidation.

The method of combining wrought with cast iron, by Stirling's process, was also described, and the great tenacity and strength of the metal was fully admitted.

February 10th, 1852.

The paper read was,—*The construction and duration of the permanent way of railways in Europe, and the modifications most suitable to Egypt, India, &c.*, by Mr. W. B. ADAMS.

This paper was an historical record and critical examination of the various parts, together forming the "permanent way," and of the numerous changes that it had undergone. The requirements that had been gradually developed, as necessary for

accomplishing this object, were enumerated, and may be concisely stated to consist in a well-drained substructure, regulated, as regards strength, according to the weight of the engines and the amount of the traffic, firmly seated in the ballast,—the rails being stiff enough to resist deflection, sufficiently hard not to laminate, and so broad as not to crush; smooth, so as to offer the least friction, and properly inclined, especially on curves, so as to fit the wheels; and the joints so arranged as to make the bars continuous, and yet to admit of contraction and expansion.

The different kinds of rails, from the flat tire-bar and edge-rail, used on colliery lines at the time of the introduction of railways,—to the parallel and bridge-shape rails now generally adopted, were examined; and also the girder-rails, for doing away with the sleepers and other extraneous means of support, in the hopes of effecting a saving in the cost of maintenance. Of the girder rails, the saddle-back pattern, introduced by Mr. W. H. Barlow, M. Inst. C.E., was the one most generally known; but it was suggested, there would be some difficulty in the packing of this rail, and if, as was asserted, it really was a rigid girder, though the draught might be lessened, the tyre of the wheels would roll down the rails to a corresponding angle with themselves. The mode of connection of this rail, by a piece of nearly similar section, to which it was firmly rivetted, was objected to, on the ground of there being no allowance for expansion and contraction;—the strength of the joint depending entirely upon that of the rivets. Many modifications in the form of the girder-rail were suggested; among them a T section, with a rail or rib on the upper surface, and a vertical portion below,—giving stiffness, and forming a solid web for ramming the ballast against.

The supports for the rails were next considered, and the reasons for abandoning stone blocks were attributed, in some degree, to their hardness and rigidity, which caused much noise; but principally to the difficulty of packing and maintaining the way, owing to their depth, to the chairs cutting into the stone, and the spikes working loose. The adoption of timber sleepers, first on newly made embankments, afterwards universally,—their size and number to each length of rail, and the proportionate area to the length of bearing—the necessity for their being sunk into the ballast, and yet to have such an amount under them as to prevent their being depressed in the ground, was also treated of, and a comparison instituted between cross-sleepers and longitudinal timbers; from which it appeared that, when their bearing surfaces were equal, the quantity of timber used in each would be the same, and, provided the quality was similar in both cases, which it ought to be, the cost of this portion of the way would also be the same. The longitudinal system certainly afforded great stiffness to the rail, and offered great facilities for packing; but, on the other hand, the timber was more crushed than in the cross-sleepers, the fastenings were less effectual, and were

more difficult of access. For the purpose of obtaining greater durability in this portion of the way, and at the same time to preserve the elasticity afforded by the timber substructure, Mr. Reynolds had designed a combination of wood and iron, the wood to which the rails were attached being placed in a cast-iron trough, triangular in section, with the apex downwards. This system, however, did not meet with much favor, and more recently various contrivances had been suggested, and in some instances tried successfully, for doing away entirely with the timber work in the substructure. In the "dish-cover" cast-iron sleeper—invented by Mr. Greaves, of Manchester, and now, it was said, about to be used in the Egyptian railway—the packing was accomplished from the surface through two small holes; and in the system introduced by Mr. P. W. Barlow, the rail was held in two cast-iron vices, which formed so rigid a road that there was not the slightest elasticity in it. A modification of this plan, by Mr. W. H. Barlow, in which the sleeper was cast in one piece, with a chair-head on it, and in which the rail was secured by a wooden key, was a slight improvement on the previous method. Mr. Samuel had proposed that the rail should be held in a compressed wooden cushion or vice, set in a cast-iron sleeper or trough, but not continuous; and Mr. Hoby, that the sleeper should consist of an elongated chair of the ordinary form, the rail being fastened in it by means of a pair of folding wedges. From what had been done, it might safely be concluded that cast-iron might be advantageously employed, provided it was in large masses and formed a continuous support; unless, indeed, the rails were so strong in themselves as to be non-deflecting.

The different modes of fastening the rails in the chairs at the joint, so important to prevent *déraillement*, were then alluded to, and the failure of the wooden keys, at first used, was attributed to their being ridiculously small; iron spikes were substituted for them, but they also were obliged to be abandoned; and then larger wooden keys were again adopted: in some instances they were compressed, like the trenails, by the process of Messrs. Ransome and May, who likewise had introduced a chair to be used with them.

The last point to be noticed in the formation of permanent way, was the establishment of a firm connection between the rails, so as to form them into one continuous bar, and to remove all the evils attending bad joints. On the Blackwall Railway, the ends of the rails were originally scarfed,—that was previous to the use of locomotives on this line,—but this weakened the ends and reduced the available length of each rail. Subsequently the addition of fishes on both sides of the rails was proposed: various modes of accomplishing the same object were given; at first of cast, afterwards of wrought iron, and then only to touch at top and bottom; these fishes were laid in the channel of the rail, and, in the first place, were supported at the ends by chairs; but

as fresh castings had to be made to receive them, it was thought better to have holes in the rails and fishes, and to pass a bolt through all,—the holes in the rails being made larger than those in the fishes, so as to allow of expansion and contraction. To meet the objection to the increased cost of this plan, Mr. Samuel, in 1849, proposed that a chair should be cast with only one jaw to fill one channel of the rail,—the other being occupied by the fish.

In Egypt the dry heat of the atmosphere was fatal to timber, and the soil along which the line would be carried would vary from the extreme moisture of irrigated land to parched dust. Therefore the deeper the foundations of a discontinuous sleeper-road could be placed, the better chance there was of their remaining firm. In the flat parts of India two evils had to be guarded against; the one, the floating up of a line during rainy seasons, if much timber was used; the other, the ravages of the white ant, which might possibly be prevented by creosoted timber; but this, in dry weather, would be liable to be fired either by hot coke or the burning sun. And in both these countries, as well as in the Australasian colonies, where fences and police could not well be maintained, an absence of anything which could be easily pilfered was a great desideratum: there should be few parts, and easily put together, so as to require little skilled labor, where such labor would be dear.

Under all these circumstances, it was submitted that an iron girder-rail, of simple construction, hollow, so as to preserve as nearly a uniform temperature as possible, under the extreme variations of temperature between day and night, would be the most efficacious, the simplest, and eventually the cheapest.

SOCIETY OF ARTS.

January 7th.

On the chemical principles involved in the manufactures of the Exhibition, as indicating the necessity of industrial instruction.

 LYON PLAYFAIR, C.B., F.R.S.

THE lecturer introduced his subject, by remarking, that chemistry is not so much a *deductive* as an *experimental* science. Before it could be applied to the purposes of industry, its experience had to accumulate, and its teachings to be appreciated and systematized. It is not, therefore, surprising, that it is one of the last of the sciences which, as a branch of systematized knowledge, has offered its services to man; yet, during its short existence as a separate science, it has increased human resources and enjoyments to a greater degree than any of its elder sisters. If this can be shewn by proofs derived from the Exhibition, it will naturally follow, that the study of chemistry is essential to

those engaged in manufacturing industry. On examining the various applications of chemical science to manufactures, they will be found to divide themselves under the following three heads:—

1. Chemical appliances which have added to human power, either by furnishing substitutes for mechanical contrivances, or by affording tools and methods of arriving at results formerly impossible.

2. Methods of producing economy of time, generally resulting from a constant tendency to simplification.

3. Methods of utilizing products apparently worthless, or of endowing bodies with properties which render them of increased value to industry.

As an example of the teachings of chemistry, the lecturer selected the smelting of iron. He said, the mode of smelting iron consists in mixing the ore with lime and coal;—the former producing a slag or glass with the impurities of the ore, while the coal reduces the oxide of iron to its metallic state. Much heat is required in the process of smelting; but the cold air blown in, as the blast, lowers the temperature, and compels the addition of fuel, as a compensation for this reduction. Science pointed to this loss; and now the air is heated before being introduced to the furnace. The quantity of coal is wonderfully economized by this application of science; for, instead of seven tons of coal per ton of iron, three tons now suffice,—and the amount produced in the same time is increased nearly sixty per cent. Assuredly this was a great step in advance. Could science do more?

Professor Bünsen, assisted by the lecturer, examined the furnaces, in each portion of the burning mass, so as fully to expose the operations in every part of the blazing structure. The furnaces are charged from the top, and the materials gradually descend to the bottom; with the upper charge a long graduated tube was allowed to descend, and the gases streaming from ascertained depths, were collected and analyzed. Their composition betrayed with perfect accuracy the nature of the actions at each portion of the furnace; and, the astonishing fact was elicited, that, in spite of the saving produced by the introduction of the hot blast, no less than $81\frac{1}{2}$ per cent. of fuel is actually lost—only $18\frac{1}{2}$ per cent. being realized.

Without the aid of chemistry, it would have been impossible for textile fabrics to have attained their present development. The bleaching of cotton and linen was not much practised in England until about a century since. Before that time, they were sent to Holland, where the operation of bleaching consisted in steeping them in potash for a few days, afterwards for a week in buttermilk, and then exposing them for several months in a meadow to the influence of the sun and moisture. A great improvement was made in Scotland, by substituting sulphuric acid for sour milk; and the immediate effect was, to reduce the time from eight to four months. In 1785, a French chemist suggested

the use of chlorine, as a means of hastening the process; and, in the last year of the eighteenth century, a compound of this gas with lime was introduced by Tennant, of Glasgow. The development of the cotton manufacture now became immense. By a happy adaptation of other chemical processes, in conjunction with the bleaching power of chlorine, the time required for the whitening of cotton and linen fabrics was at once reduced from months to hours, while the miles of outstretched calico, defacing the verdure of country districts, disappeared, the whole operation being carried on within the small space of an ordinary factory. You may imagine what an impulse this gave to a trade so important to us. The bleaching of calico now consists of a chemical operation of great precision; that of silk and wool has not yet been so thoroughly comprehended by science, and consequently has not derived so many advantages from its application.

Calico-printing is an art which has grown with the growth of chemistry and strengthened with its strength. The knowledge of mordants and of colors, and the other results of chemical discoveries, are of every-day occurrence. Let us take one of the last examples. Lapis lazuli, long celebrated for its beautiful blue, almost ranked among the precious stones, and was sold at a price which put it quite out of the reach of the calico-printer. But chemists, ascertaining its composition, by analysis, soon learned how to make it by synthesis. Artificial ultramarine is now manufactured at three or four shillings per pound. But when it was made, how was it to be fixed on cloth? From its insolubility, its fixation was a real difficulty. Chemists suggested that the ultramarine might be mixed with albumen, which being coagulated by heat, would retain the colour on the cloth to which it was applied.

A recent application of chemistry to the economy of dyeing deserves especial attention. Madder, the dye most commonly used for calico, after imparting its color, was considered useless. The large quantities of spent madder constantly accumulating were found exceedingly inconvenient. It was not valuable enough for the manure heap, and the rivers became polluted in carrying away the waste material. But chemistry has shewn that actually one-third of the coloring matter is thus thrown away, and that simple treatment with a hot acid again renders it available as a dye.

The manufacture of leather has been less advanced by the application of chemical science than any other of the arts. Hides, steeped in an infusion of oak bark, absorb tannin, and are converted into leather. Good sole leather takes about a year to tan, and even calf-skins consume a month in the operation. Chemists have certainly indicated substitutes for bark, containing a greater amount of tannin; and these—as, for instance, *terra japonica*, cutch, catechu, and *divi-divi*—produce their effects in half the time; but the leather is said not to be so durable. With sumach, light skins may be tanned in twenty-four hours, and with the

aid of alum, even in one hour; but the resulting manufactures are not preferred to the old processes. In one respect chemistry has greatly assisted this manufacture. In removing the hair from the hides, previous to tanning, it was customary to shave it with a knife; but this process was tedious and imperfect, and has given way to the following simple one:—lime-water dissolves the bulbous root of the hair, when the hides are immersed in it for some time, and the hair may then be readily removed by a blunt instrument. By this process, one man can remove the hair from a hundred kid-skins in about an hour. Still, the immersion requires several weeks; while the addition of red orpiment to the lime, as practised by the sheep-skin manufacturers of France, reduces the time to a few hours.

When goat-skins are tanned for morocco leather, it is necessary, in order to adapt them for dyeing, to remove the lime absorbed by the last operation. A solution of *album græcum* cleanses the pores effectually, leaving them so sponge-like, that air can readily be forced through them. Hence, the process of tanning is rendered much easier, being, in fact, completed within twenty-four hours; while the leather is rendered fit to assume the colors so characteristic of morocco.

The mineral and metallic manufactures are those which obviously have derived most advantages from chemistry. Glass and pottery are, in fact, chemical manufactures. The hard-won experience of two thousand years in China has been given to Europeans by a few years' application of chemistry. Glass, made by the ancients from the ashes of ferns and other plants, is now formed by soda artificially produced from sea salt. The Exhibition shewed that this manufacture, far advanced as it is, may still be susceptible of improvement; for, in the French department, glass was shewn in which zinc and barytes were substituted for lead. The hardening and production of steel, the discovery of many new alloys endowed with properties most important to the arts, and the electrotyping of metals, are familiar examples of chemical appliances; but this very familiarity renders it unnecessary to dwell upon them.

Chemistry has produced great economy and increased power of production to the manufacturers of soap, by furnishing them with soda prepared directly and artificially from salt, instead of through the organism of plants. It has also pointed out that vegetables as well as animals produce similar fats. The fat of beef and mutton exists in cocoa beans; human fat in olive-oil; that of butter in palm-oil; and horse fat and train-oil are in many oily seeds. Palm and cocoa-nut oil now therefore largely replace the high-priced fat of the Russian oxen and sheep; although the cheap importation of similar fats from Australia and South America has rendered the substitution less necessary than formerly.

Much aid has been given by chemistry to the art of perfumery. The perfume of flowers often consists of oils and ethers, which

the chemist can compound artificially in his laboratory. Commercial enterprise has availed itself of this fact, and sent to the Exhibition, in the form of essences, perfumes thus prepared. Singularly enough, they are generally derived from substances of intensely disgusting odour. A peculiarly fetid oil, termed "fusel oil," is formed in making brandy and whisky. This fusel oil, distilled with sulphuric acid and acetate of potash, gives the oil of pears. The oil of apples is made from the same fusel oil by distillation with sulphuric acid and bichromate of potash. Again, many a fair forehead is damped with *eau de millefleurs*, without knowing that its essential ingredient is derived from the drainage of cow-houses.

The manufacture of candles has recently been much improved by the aid of chemistry. Tallow candles, or their more expensive substitute, wax, were generally used till within the last twenty years. The tallow itself was long very impure, containing cellular tissue, which was only partially removed in the form of a scum, known as "cracklings." This impurity rendered the light unsteady, and obstructed the wick. The old method of purification, still largely used in this country (though superseded on the continent and in Dublin, whence such good tallow candles were exhibited) has been displaced by a process of treating with sulphuric acid the tallow melted by steam. Much of the smell is thus removed, and a larger amount of a purer tallow is obtained. The researches of Chevreul had shewn that fats consist of fatty acids, combined with a kind of sugar named glycerin, which it was important to remove: this glycerin, removed in candle-making, is now used as liniments in cutaneous affections, and is employed as a remedy in deafness and rheumatism. By boiling with lime, an insoluble soap is formed, while the glycerin remains dissolved in the water. This lime-soap, decomposed by a stronger acid, yields the fatty acids in a pure state. But there are generally two solid acids mixed with a fluid one; and the latter is easily removed by pressure—the solid fats remaining. The solid acids are made into the beautiful candles erroneously called "stearine."

The manufacture of coal-gas is an admirable example of the benefits conferred by chemistry in all the three divisions of its uses; for it not only has economized human power and time, but it has utilized all the products employed in removing its impurities. Coal-gas when first introduced had an insupportably fetid odour, and certainly injured health when burned; it discolored the curtains, tarnished the metals, eat off the backs of books, and covered everything with its fuming smoke. It required a man of courage, as indomitable as Winsor, its great advocate, to persuade the public to continue its use until means were found for the removal of these noxious qualities. Here chemistry, itself the father of the manufacture, was called in consultation. The impurities in the gas are sulphuretted hydrogen, which tarnished the metals, and, with sulphuret of car-

bon, produced sulphureous fumes; ammoniacal compounds, which changed the colors of dyes and acted on leather; tarry vapors, which caused the deposition of soot;—and all these had to be removed. The ammonia and the tar were partially condensed in tubes kept cool. The sulphuretted hydrogen and carbonic acid were removed by lime, and the ammonia by washing the gas with water. This last operation was the least effective, and new substitutes had to be devised, one of which was superphosphate of lime, consisting of bones dissolved in sulphuric acid, only requiring ammonia to make it a powerful and excellent manure: trays of this superphosphate were therefore placed in a chamber through which the gas passed, and thus the ammonia was removed, while the phosphate became enriched. A new method is now extensively employed, and shews the tendency to simplification resulting from discovery. By this method almost all the conditions of purification are satisfied by one process; the gas, after cooling, is at once taken into a chamber containing carbonate of lime and sulphate of iron; and these, reacting upon each other, produce oxide of iron and sulphate of lime. The gas, streaming through this mixture, gives up its sulphuretted hydrogen to the oxide of iron; while the carbonate of ammonia, decomposing the lime salt, forms sulphate of ammonia and carbonate of lime,—the lime thus being reconverted to its original state.

The lecturer concluded his address by an eloquent appeal on behalf of the professors of abstract science, who are the horses of the chariot of industry. He considered that their social position required to be raised; their sphere of action debarred them from the acquisition of wealth; and therefore, without the addition of some honorary distinction, their pursuits offered but few attractions to ambitious spirits. It was clear that the study of abstract science had done much for other countries; and that so long as this important branch was left unregarded, we must be content to meet with not merely successful rivals in the useful arts, but also to submit to the inevitable fate that awaited us, viz., to be outstripped by those nations who have already recognized the fact that industry must in future be supported, not by a competition of local advantages, but by a competition of intellect.

Jan. 14th, 1852.

Substances used as food, illustrated by the Great Exhibition.
By JOHN LINDLEY, Ph.D., F.R.S.

THE lecturer commenced his notice of alimentary substances by referring to wheat, which he remarked, in its connection with the Great Exhibition, presented some features particularly deserving to be brought under public consideration. There is, he said, now before us a sample of wheat from Adelaide, which is, probably, the most beautiful specimen of corn that has ever been brought.

to market in any country. It is a white wheat, in which every grain appears to be like every other grain—plump, clear-skinned, dry, and heavy—weighing (what may seem incredible to those who are only accustomed to common wheat) seventy pounds a bushel. And it appears that Adelaide is capable of yielding vast quantities of corn of this description, which takes the lead in the markets of this country over all other white wheats.

It has been supposed that all we have to do, in order to obtain, on our English farms, wheat of the same quality, is, to procure the seed and sow it here. There cannot be a greater mistake. The wheat of Australia is no peculiar kind of wheat; it has no peculiar constitutional characteristics by which it may be, in any way, distinguished from wheat cultivated in this country. Its quality is owing to local conditions; that is to say, to the soil and climate of South Australia.

The lecturer next alluded to the improvement of cereal crops. He said, if you can double the size of a turnip, or if you can double the size of a rose, or produce a hardy race of any kind from one that is tender, or the reverse, in the case of ordinary plants, you should be able to produce the same effect when operating on cereal crops. In the last treatise on this subject, by Dr. Gærtner, a German writer, who has collected all the information it was possible to procure, relating to the production of hybrids in the vegetable kingdom, the author declares that, as to experiments on cereal plants, they can hardly be said to have had any existence. The Exhibition has, nevertheless, shewn us that they have been made, and some examples will tell with what result. For instance, Mr. Raynbird, of Laverstoke, who obtained, in 1848, a gold medal from the Highland Society, for experiments of the kind, sent to the Exhibition a box (produced to the meeting) containing a bunch of Hopetown wheat, a white variety, and a bunch of Piper's Thickset wheat, which is red. The latter is coarse, and short-strawed, and liable to mildew, but very productive. Mr. Raynbird desired to know what would be the result of crossing it with the Hopetown wheat, and the result is now before us in the form of four hybrids, obtained from those varieties. If you will take the trouble to examine them, you will see that, beyond all doubt, the new races thus obtained are intermediate between the two parents—the ears are shorter than in the Hopetown, and longer than in the Thickset wheat; in short, there is an intermediate condition plainly perceptible in them throughout. Mr. Maund, a very intelligent gentleman, residing at Bromsgrove, has been occupied, for some years past, in the endeavour to ascertain whether something like an important result cannot be produced upon wheat by muling, and the specimens before us are evidence of what may be done. You will observe, that sometimes his hybrids are apparently very good, and sometimes worse than the parents, as we know is always the case. In each instance the male parent is on the left-hand, the female on the right,—and the third specimen shews the result of

combining the two kinds; a better illustration could not be desired. There is no reason to doubt that an ingenious person, occupying himself with such matters, will arrive at the same improvements, in regard to varieties of corn, as have already been obtained in the animal kingdom, and in those parts of the vegetable kingdom which have been so dealt with.

Fecula is, as is well known, a granular matter, found in the interior of plants, and peculiar to the vegetable kingdom. It exists in all plants. Pure fecula is separated by art from a great variety of species, where it is placed in unusual abundance, for purposes connected with the wants of the plants which contain it. Before us to-night are examples of it,—one being an entirely new, and another a somewhat novel, source of fecula; we have here, in fact, a kind of arrow-root, not of bad quality, but very good and pure, and probably, for dietetical purposes, as useful as the arrow-root of Bermuda. Although not quite new, it is very little known, and is obtained from the stems (on the table) of a plant, which the people of St. Domingo call *Guayiga*. There is no reason, perhaps, to suppose that it will be of importance in our commerce with St. Domingo; but what is curious with regard to it is, that there is a sample of the same substance obtained in Western Australia from a plant called *Zamia Australis*, growing abundantly, and yielding even better fecula than the guayiga of St. Domingo: both of these sources were hitherto unknown, or scarcely attended to.

There is another curious substance, specimens of which were furnished from the museum at Kew Gardens. These are cakes of typha bread from Scinde and from New Zealand, where they are articles of food, prepared from the pollen of the common reed-mace, or bulrush, of those countries. These are, perhaps, the only cases known of the pollen of plants being used for food, under any circumstances whatever; and it is not a little curious that countries so far apart as Scinde and New Zealand, should have the same most unusual kind of diet.

Passing by similar matters of curiosity, the lecturer next referred to plantains. In Mexico, he said, such articles, in a dried state, enter largely into the consumption of the people in the mining districts. Dried plantains possess considerable nutritive value, and are, at the same time, exceedingly agreeable to the palate; while they are cheap and easy to prepare, and have the property—which many such substances do not possess—of keeping for a very long time.

The Exhibition contained some examples of dried vegetables, prepared by what is called Masson's process. They were packed in tin-foil, and very imperfectly secured; they have been affected, though not injuriously, by the dampness of the building in which they have been kept. The samples consist of white and red cabbages, turnips, Brussels sprouts, and various other things. The mode of preparing these vegetables is shortly as follows:—They are dried at a temperature from 104° to 118°, and made to give

up from 87 to 89 per cent. of their water ; after which, they are forcibly pressed into cakes, and are ready for use.

A great deal of interest was excited, when the contents of the Exhibition first became known—and it did not diminish afterwards, by a certain meat-biscuit introduced among the American exhibitions from Texas, by Mr. Gail Borden. We were told that its nutritive properties were of a very high order ; it was said that ten pounds weight of it would be sufficient for the subsistence of an active man for thirty days. Colonel Sumner, an officer in the United States dragoons, who had seen it used during field operations, names five ounces a day as the quantity for the support of a man. This meat-biscuit is capable of keeping well, as no foreign matter is introduced into its composition ; no salt to absorb moisture ; nor any thing else to interfere with the property of flour, or of essence of meat. These biscuits are prepared by boiling down the best fresh beef that can be procured in Texas, and mixing it, in certain proportions, with the finest flour that can be there obtained.

In speaking of coffee and cocoa, the lecturer referred to some specimens of cocoa from Trinidad. Cocoa, he said, is an article of very large consumption ; and it, moreover, forms the basis of chocolate. In this country we never get good cocoa ; and the consequence is, that all the best chocolate is made in Spain, in France, and in countries where the fine description of cocoa goes. We get here a cocoa which is unripe, flinty, and bitter, but it comes from British possessions, and is therefore sold here subject to a duty of only 18s. 8d. per cwt., whereas, if it came from a foreign country it would pay 56s. The differential duty drives the best cocoa out of the English market. Still it appears that we might supply, from our own colonies, this very cocoa ; because Trinidad furnished a very beautiful sample, quite equal to anything produced in the best markets of the Magdalena, of Socomusco, or of other places on the Spanish Main.

A preparation of coffee-leaves was sent, by Dr. Gardner, to the Exhibition, to be used as a substitute for tea. One of the reasons assigned for this substitution is, that you obtain from coffee the same alkaloid, *theine*, that you obtain from tea ; and it is that alkaloid which gives tea its value as an article of diet.

The Turks contributed an odd material called kinguel, which is a grain, or seed-vessel, employed by them as a substitute for coffee—whether for adulterating or improving its quality, they do not tell us. It is unknown in this country as an article of use, and is the seed-vessel of a plant called Gundelia.

Reverting to the subject of sugar, the lecturer said that there was a most curious series shewn in the French department, which, for the singular and beautiful illustration it gave of the application of science to manufacturing processes, deserves to be particularly noticed. In the manufacture of beet-root sugar there is a residuum, as there is in sugar made from the sugar cane—*molasses*.

sea, a brown, sweet substance, containing a great deal of sugar, which cannot be recovered. The beet-root molasses has this serious fault—it is nauseous, and utterly uneatable, except by pigs: it is, therefore, sold at a very low price, and is generally given to animals. But it occurred to M. Dubrunfaut that this molasses might be compelled to give up its sugar, and he invented what is called the barytic process, in order to separate it. To the useless molasses of beet-root he adds hydrate of baryta, which combines with the saccharic acid, or sweet principle, and produces a saccharate, or sucrate of baryta, an insoluble substance; the coloring and other soluble matters are then washed out; and thus from this dark substance, acted upon, in the first instance, by the hydrate of baryta, you obtain a body which is perfectly colorless. It is next necessary to get rid of the baryta, it being poisonous; and carbonic acid is used for that purpose. Carbonic acid being introduced, a carbonate of baryta is formed,—the baryta goes over to the carbonic acid, and the sugar is left. The sweet fluid is then subjected to clarification, by straining through animal charcoal and sulphate of lime, and becomes a colorless substance, extremely sweet, and perfectly free from baryta. Thus is obtained a kind of *cane sucré* from the black and, I may say, fetid molasses: the final result is, the recovery of from 35 to 45 per cent. of sugar.

The Exhibition contained an extraordinary and most valuable collection of Chinese teas, procured by Mr. Ripley, of Canton. Among the examples was a sample of tea called superfine flowery pekoe, which cost, in China, 50s. a pound,—such being the value which the Chinese place upon it. In this country it can be only a fancy tea, exceedingly delicate, no doubt, but possessing qualities to which we ascribe little importance.

The collection also contained samples of tea from Assam, and others from the Himalaya mountains, furnished by Dr. Royle. The cultivation of tea in the Himalaya mountains, where a similar cold temperature, and circumstances of the same nature as in the tea districts of China, exist, is due to Dr. Royle. Judging from *a priori* considerations, he was of opinion that tea would succeed completely on the hills of Northern India. He recommended, in 1827, the attempt to Lord Amherst, who was then Governor-General, and afterwards to Lord William Bentinck, who commenced the experiment at his suggestion. In 1847, 162 acres were occupied by tea-plantations on the Himalayas; and at that time the tea was selling at Almora, the green for 9s. and 10s. a pound, and the black from 4s. to 7s.: the quantity of ground now covered is 656 acres of public land, exclusive of all that in the occupation of Zemindars, who are most anxious to form tea-plantations.

In noticing the contribution of honey to the Exhibition, the lecturer took occasion to speak of the hives. He said, we found a great quantity of hives, which were generally remarkable for

being unsuited to the insects that were to inhabit them. Bees require, above all things, to be left alone; to be perfectly tranquil; and we found double hives, with one so drawn over the other that you could not take off the outer hive without shaking the inner one. Bees require an atmosphere, sometimes warm and sometimes cool; and we found hives made with ventilating contrivances of pierced zinc, most ingeniously adapted to occupy the time of the bees in filling up the holes when they do not want them, and opening them again when they do. Bees require ready access to their hive in summer, and the means of closing up the access in winter; we found hives made with openings so narrow, and the access so small, that not more than two bees could enter at a time. Bees have enemies to contend with;—mice and snails—tom-tits pop their heads in, when they can, and carry the bees off: we found hives apparently contrived for no purpose except to let mice and such creatures in. Bees require an equal temperature,—not over hot in summer, and not over cold in winter; we found hives made of metal plates: I had the curiosity to write to a person who had used one of these hives of great, even royal, pretensions, to enquire what had become of his bees; his answer was, "They have all perished, or flown away!" It is known that angles in the interior of hives are exceedingly disadvantageous; because it is in the angles that the wax-moth, the greatest enemy to bees, makes a lodgment: we found hives extremely angular; hives, indeed, provided with angles, multiplied with singular pains. In short, we saw nothing to commend or to admire in the hives exhibited (I speak of the English hives), excepting one small improvement in the form of the common hive. It is not a truncated cone, as all hives to carry glasses are, but is more like a hemisphere, with a flat board put upon the top. This was exhibited by Mr. Milton, of Marylebone Street, the most skilful of our apiarians.

In conclusion, the lecturer said, the Great Exhibition has demonstrated, that although new kinds of food are not to be expected (and it seems hopeless to look for them), yet that means exist of materially improving both the quality of what we have, and the mode of its preparation; and, moreover, that we need not despair of discovering still other sources from which some of the articles we now use may be more abundantly and economically obtained than is the case at present.

Jan. 21st, 1852.

On the vegetable substances used in the arts and manufactures in relation to commerce generally. By PROFESSOR EDWARD SOLLY, F.R.S.

THE lecturer prefaced his remarks on the raw materials of the vegetable kingdom, by noticing the ill effects arising from the

want of direct communication between the first producer and the manufacturing consumer. In deprecation of this state of things, he said, it might be taken as a pretty well-ascertained fact, that only those manufactures are in a really progressive state, of which the producer of the raw material and the manufacturing consumer are in more or less direct communication, and where there is a mutual knowledge of the capabilities of the one, and the requirements of the other. When there are many intermediate agents between the two, it is long before the complaints of the manufacturer reach the ears of the first producer, and it must be many years before the improvement which the former desires can be brought about.

The Great Exhibition was said to present a most valuable and interesting collection of the gums, resins, oils, dye-stuffs, fibres, and timber of many countries; necessarily far from complete, but still highly useful, because along with those substances well known to our manufacturers, there were samples of many which are wholly unknown; and not a few of those, which having been brought over in former years, and condemned and discarded because their use had not been discovered, are now beginning to excite attention, and are likely in time to become articles of commerce. This department of the Exhibition offered one peculiar advantage, namely, that it not merely recorded the successes, but also, to some extent likewise, the failures of past years. In examining these forgotten materials, we are naturally led to inquire into the reasons why they met with so little favor; we are induced to study the modes in which they were tried, and the causes which led to the failure of their employment. If these inquiries teach us the reason why former attempts failed, they may very probably suggest new modes of working, better suited to the properties and peculiar characters of each substance; or, indeed, they may perhaps lead to altogether new uses and new applications.

The collections of gums and resins in the Great Exhibition were said to contain a great variety of kinds, many of the finest and best of which are not at all used in the arts; but there is no doubt that if those manufacturers who use gums and resins were well acquainted with the better sorts, they would soon learn to discard the inferior varieties. For example, the fine red resin of the *Xanthorrhoea* of New South Wales, which, though it has been known in our museums for more than half a century, is only now beginning to be used by manufacturers, and which will unquestionably ere long increase in estimation and demand. In a similar condition stand the beautiful Cowrie resins of New Zealand, the East Indian Dammers, and the fine hard resins from Coorg. These resins all require a peculiar treatment, different from that employed with the ordinary resins of commerce: treated as those substances commonly are, they will be found refractory and useless; but by new processes, and under the in-

fluence of different solvents, their real value will in time be developed.

In connexion with gums was noticed artificial gum, which is now so largely made for the use of calico-printers and others, by roasting starch, and known under the name of "dextrine" or British gum.

India-rubber, it was remarked, was, a century ago, known only as a curiosity—now it is regarded almost as a necessary of life, and of late not a year has gone by without some new and valuable application of this remarkable substance. A few years since, the demand for India-rubber had increased so much, that importers began anxiously to look out for new sources, especially as the supply from South America was beginning to fail. A little inquiry shewed that abundance of milky-juiced plants, yielding excellent caoutchouc, flourished in the forests of tropical Asia; and from various parts of the East Indian empire, Assam in particular, excellent samples were sent.

Since this time that singular substance, gutta-percha, has been introduced, and there are doubtless many similar substances which might be brought with advantage under the notice of English manufacturers. There were several new and peculiar substances of this class shewn in the Exhibition, among which the Cattimundoo (contributed from Vizianagram) possesses many of the properties of gutta-percha, and is likely to become a valuable import.

On turning to the great class of vegetable oils, we find the same rich abundance of nature to admire. Cocoa-nut and palm-oil have been extensively imported from Ceylon and the coast of Africa, chiefly for the manufacture of candles; but there are, besides these, at least two dozen other solid vegetable oils, almost unknown to commerce, and well worthy the attention of manufacturers, such as the vegetable tallow of the *Vateria indica*, the fat of the various *Bassias*, the oil of the *Carapa*, the oils of the *Garcinia* and of the *Vernonia*, the vegetable tallows of China and the Archipelago Islands. The various vegetable waxes, too, of which there are likewise many, and which may be had largely in Mexico, South Africa, and North America, deserve notice. Some of these substances are already becoming known to manufacturers, especially certain of the kinds of vegetable tallow from China; and the importation of vegetable wax is increasing. Till recently, indeed, the latter substance could not be imported into England, for the high duty imposed upon it amounted to a prohibition. Whilst bees' wax paid a duty of 10*s.* per cwt., vegetable wax was charged 5*l.* 12*s.*, or at the rate of 112*l.* per ton. Recently the duty has been equalized, and the protection which long existed in favor of bees has been withdrawn.

Amongst the fluid fixed oils similar facts are to be observed; there are many excellent oils wholly unknown to commerce, but admirably adapted to the wants and requirements of manufacturers.

Several of the little known volatile oils were highly interesting; the sweet-scented, fragrant ones, are all of value, though their importance in the arts is fast diminishing, as the progress of science brings us nearer and nearer to the mode of preparing them artificially. Amongst these oils several are of value, in consequence of their strong solvent powers over resin. Thus, for example, we have the excellent oil of the *Eucalyptus piperita* and *Leptispermum*, from New South Wales;—that country, yielding at the same time valuable resins, and essential oils capable of dissolving them, and thus of rendering them practically useful in the arts.

There is, perhaps, no art which has undergone more important changes and alterations during the last half century than that of dyeing; and here, as in all other branches of applied science, we find many points of interest in studying the vegetable raw products employed. The value of vegetable dye-stuffs depends on the care bestowed on their cultivation, and upon the attention paid to their collection and preservation, so that they may not suffer injury, either from carelessness or from adulteration. The importance of vegetable coloring matters, generally, is somewhat diminished by the numerous chemical discoveries which have introduced to the dyer mineral or inorganic substitutes for many of them; but by its aid the dyer is now able to get many colors from the old vegetable dye-stuffs, which were quite out of the power of his predecessors. The improvements in calico-printing, and dyeing in many colors, have gradually given rise to a demand for new colors and new dyes; so that at the present time good or promising new colors are received with a considerable degree of interest. Owing to the progress of the art many coloring matters, which a few years since were regarded as of little or no value, are gradually rising in estimation. Munjeet, Chay root, and many other dye-stuffs, are in this manner gradually coming into use.

Dye-stuffs, for the most part, are bulky heavy substances, the carriage of which for any distance by land, or even by water, makes a very serious addition to their cost. Here chemical science might be applied with great advantage, for if our colonists could be taught how to extract and concentrate the true coloring principles from dye-woods, not only might much unprofitable labor and expense be saved, but these concentrated dye-stuffs might be imported from places from which the cost of carriage would altogether prevent the importation of the dye-stuff in its raw state.

Cotton, of which this country imports at present about eight hundred million pounds a-year, is chiefly obtained from the United States; for about 84 per cent. of the whole quantity of cotton annually consumed in Great Britain is imported from North America; about 10 per cent. from the East Indies; nearly 4 per cent. from Brazil; and rather more than 2 per cent. from

the Mediterranean. In North America the cotton plant grows freely and luxuriantly, and its cultivation and the collection of the fibre have reached such a state of systematic excellence, that there appears little further improvement to desire. The Sea Island cotton is long and yet fine, strong, and at the same time silky. Next in importance as cotton-producers stand the British possessions in the East. The native cotton of India has a far shorter fibre than that of North America; little care is bestowed on its cultivation and collection, and little care is taken to protect it from injury after it is collected. The attention of the East India Company is now fairly directed to the improvement of the cotton cultivation, and there is little doubt that, ere long, any quantity of sound and good cotton may be imported for the use of manufacturers from British India.

While speaking on the subject of cotton, the lecturer called attention to Mr. Mercer's new process for modifying its chemical and physical properties. The fibre of cotton, he said, when examined by a lens, is found to consist of a flattened or ribbon-shaped tube; when treated with a cold strong solution of caustic soda, as in Mr. Mercer's process, it appears to shrink, and assumes the form of a simple cylinder; thus three important and very remarkable alterations occur at the same time,—the fibre becomes stronger, it acquires increased attraction for coloring matter, and it becomes smaller: the process is at once cheap and effectual, and the cotton is decidedly increased in value.

In speaking of flax, the lecturer commended the process of retting lately introduced into Ireland, and known as Schenck's process; but he expressed himself as not very sanguine of the success of Mr. Claussen's plans for treating flax.

In noticing the third division of vegetable fibres, the lecturer said, we have here a wide and very comprehensive subject opened out to our consideration; namely, the various substitutes for flax and hemp. The most important of these at present in use are Jute, the fibre of certain species of *corchorus*; Sun, the fibre of the *Crotalaria*; Manilla hemp, obtained from *Musa textilis* and *paradisiaca*; Coir, the fibre of the cocoa-nut; pine-apple fibre; New Zealand flax; China grass, and Calocoe hemp, obtained from various species of *Urtica*; but it is by no means certain that these are so good or valuable as some of the less generally known vegetable fibres. Amongst the fibres of India, and of South America in particular, there are several which promise hereafter to be of the greatest value, as the *Jetee*, or bow-string hemp of Rajnehal; the fibre of the *Calotropis* or *Aeclepias tenacissima*, and the fibres of the *Sanseveria* and *Hibiscus*.

The beautiful silk cotton obtained from the *Bombax* and other trees in various parts of the world was also noticed as being a fibre short and remarkably elastic, though at the same time, unfortunately, very tender. It is in India spun into a loose and coarse, but very warm, cloth; whilst in Europe it is generally

considered as of no value: lately it has been applied advantageously in America to the manufacture of silk hats, for which purpose it is said to answer admirably. Of these fibres, likewise, almost unlimited quantities may be had.

In reference to timber, the lecturer stated, that the quantity of wood of all kinds annually imported into Great Britain is not much less than ten millions of cubic feet; it is therefore a question of no small moment to know from whence we are to obtain such an enormous quantity in future years; which are the best woods, and from whence we may expect to obtain them most economically, and with the least risk of failure in the supply.

The number of woods at present admitted as first-rate for ship-building purposes is not more than eight; namely, English oak, live oak, African oak, teak, saul, greenheart, morra, and iron-bark—the latter only admitted as a first-class wood since the opening of the Great Exhibition: the number used in ordinary architecture is, of course, far greater; and the number used for the ordinary purposes of the carpenter is very large; because, in each country, the strongest, cheapest, or handsomest woods are employed, according to the purpose for which they are required. So large and important a collection of woods were never before brought together as we had recently an opportunity of examining in the Great Exhibition. There were good specimens of the well-known old woods of commerce; specimens of most of the new ones recently introduced, and of a multitude of woods wholly unknown to commerce, a good many of which possess qualities calculated to render them highly valuable in the arts.

Amongst the less generally known woods lately introduced into commerce, mention may be made of the morra and greenheart of British Guiana, both excellent for ship-building; and the muskwood, blackwood, Huon pine, and blue gum of Van Dieman's Land; the three former valuable as beautiful ornamental furniture woods; the latter an enormous timber tree, which promises to become of much importance for ship-building. Fine samples of the wood of various species of Eucalyptus were also contributed from Western Australia.

Amongst the South African woods, was one deserving of notice, exhibited under the name of red ebony; of the tree which produced it nothing is known, but its nature is so peculiar, and its properties as an ornamental wood are so valuable, that it is a substance of considerable interest. It is dense and tough, has a fine red color, and is so close and uniform in grain, that it resembles ivory rather than wood.

The lecturer, in concluding his address, urged the necessity of founding a Museum of Industry; remarking, that in this branch of education not only were the means wanting for teaching the scholar, but that the information had yet to be collected which the schoolmaster was required to impart.

Scientific Adjudication.

COURT OF COMMON PLEAS.

Before Lord Chief Justice Jervis and a Special Jury.

Feb. 9th, 1852.

MITCHELL v. BARBER.

THIS was an action arising out of an application to the Master of the Rolls for an injunction to restrain the defendant from working certain knitting machinery, alleged to be an infringement of a patent granted to a Mr. Bailey, of Leicester, on the 24th February, 1844, for "improvements in machinery for manufacturing looped fabrics," and subsequently assigned to the plaintiff Mitchell. The pleas put in by the defendant were, not guilty—that Bailey was not the true inventor—that the specification did not sufficiently describe the invention, and that the invention was not new and useful.

Mr. Serjeant Byles, Mr. Macauley, and Mr. Brown, appeared on behalf of the plaintiff; and Mr. Humphrey, Q.C., Mr. Webster, and Mr. Phipson, for the defendant.

The object of this invention was to increase the productive power of knitting machinery. This the inventor, in great part, effected by substituting "presser-bits" for the ordinary presser-bar, which is a straight bar stretching across the knitting-frame, and used for simultaneously depressing the beards of the needles on which the work is formed. Between each of the needles, which form a row lying in a horizontal line across the machine, is one of a series of thin slips of metal, termed sinkers, which are intended to sink the thread, destined to form the work, between the stems of the needles; and also to push the loops of work, when formed, off the beards of the needles. These sinkers, it would seem, are liable to bend laterally, and thus interfere with the efficient working of the knitting-frame; and it is by preventing this evil that the object of Bailey's invention was principally attained. This was effected by adding to the ordinary presser-bar the presser-bits before mentioned, which are thin pieces of metal, forming a kind of comb,—the acting parts of which, to use the words of Bailey's specification, "are at all times between the sinkers, and guide and protect the sinkers from bending laterally." The presser-bar, according to this patent, works in front of the sinkers; and it has a very short length of movement, which movement is independent of that of the sinkers.

In support of the plaintiff's case, Mr. Carpmael was called, who testified to the novelty of the invention, as respected some prior patents, which, on the application to the Master of the Rolls for an injunction to stop the operations of the defendant,

were said to have anticipated the plaintiff's employment of presser-bits, interposed, and at all times remaining, between the sinkers. It was admitted that, in the specification of a patent granted to a Mr. Mather the 14th November, 1837, the mutual guiding and supporting of the pressers and the sinkers was clearly shewn; but Mather's presser-bits, instead of entering from the front, came in from the back, and were worked from the back. It was admitted, in cross examination, that the plaintiff's pressers also received their motion from the back of the machine; but it was denied that the two plans were equally efficient, as Mather's presser-bits were much longer than the plaintiff's, and were therefore liable to bend, if not made to fit closely between the sinkers; and that, by so fitting, considerable friction would be created, more especially as the traverse motion over the sinkers was greater. One of the plaintiff's machines was exhibited in court; and the similarity between it and the defendant's machine—a model of which was also exhibited—was explained to the jury. It appeared that the defendant had attached presser-bits, similar to those of Bailey's, to a presser-bar, and that the bar was permanently fixed to the bar which carried the sinkers,—so that the movement of the sinkers and presser-bits were simultaneous; whereas, in Bailey's machine, they had an independent motion. Mr. Bailey, and other practical men, were called to support the case; and great amusement was created by their severally admitting, that the defendant's plan resembled more closely some machines known in the trade as manufactured under a patent granted on the 4th February, 1841, to Messrs. Cartwright, Warner, and Haywood, than the plaintiff's machine.

Mr. Humphrey, on behalf of the defendant, said that, under the circumstances, it was scarcely necessary to trouble the jury with any part of his defence; but, in order to satisfy them of the truth of the admissions of the plaintiff's witnesses, viz., that if any patent at all was infringed by the defendant, they had the wrong plaintiff before them, he should call Mr. Cartwright, one of the patentees of the patent referred to, who would tell them what he had done with presser-bits three years prior to the date of Bailey's patent. On Mr. Cartwright being sworn, he was requested to refer to his specification (the enrolled copy of which he held in his hand), and say whether it contained any reference to pressers which entered between the sinkers. From the statement of this witness, it appeared that, under the sixth head of his invention, pressers were described as entering between and in front of the sinkers; and that he had set machinery at work, constructed on this plan, before the date of Bailey's patent.

At this stage of the proceedings, the learned Judge considered there was no case for the jury; and it was ultimately arranged, that a verdict should be taken for the defendant on the plea of not guilty of infringement, and for the plaintiff on the pleas which brought into question the validity of the patent.

COURT OF QUEEN'S BENCH.

Before Lord Campbell and a Special Jury.—Feb.' 12th, 1852.

LISTER v. TODD.

THIS was an action for the alleged infringement of a patent granted to Mr. Donisthorpe, "for improvements in combing and drawing wool, and certain descriptions of hair," and bearing date July 6th, 1842; of which patent the plaintiff was the assignee.

The counsel for the plaintiff were Sir F. Thesiger, Mr. M. Smith, and Mr. Webster; for the defendant, Sir Fitzroy Kelly, Mr. Bovill, and Mr. Bayley, appeared.

It was stated that, up to the date of the plaintiff's patent, wool had been carded or combed by hand,—the wool being placed on a holding comb, and then acted on successively by combs of different gauge, the combs increasing in fineness as the operation proceeded. The introduction, however, of Mr. Donisthorpe's invention, had effected a revolution in the wool-combing trade; and, since that time, the operation had been almost exclusively performed by machinery. According to the plaintiff's patent, the wool was fed on to a circular rotating holding comb, which brought the staple under the action of a peculiarly-constructed straight comb, or series of combs, attached to a drum, rotating in stationary bearings. These combs (commonly known as the working combs) were set in a line tangential to the circular comb; and their teeth were so arranged, that the part of the comb which first acted upon the wool, carried by the circular holding comb, had the coarsest gauge of teeth,—the gauge gradually increasing in fineness as the other end of the comb was approached. By this means, therefore, the ends of the staple were first acted upon by a coarse comb, and, as the proximity of the holding and the working combs increased (from the cause above assigned), the gauge of the working comb became finer; thus allowing of the fibres being more intimately divided, and the length of staple acted upon being, at the same time, increased, until the working comb worked close up to the teeth of the holding comb. The case against the defendant was, that, as the proprietor of a patent granted to a Mr. Heilmann, of Mulhausen, on the 25th February, 1846, for "improvements in certain machines used for preparing, to be spun, cotton, wool, and other fibrous materials," he had, by a colorable evasion of the plaintiff's patent, obtained the same beneficial result as was attainable by the use of working combs, the pitch of the teeth of which graduated from coarse to fine. Witnesses were called on behalf of the plaintiff, to testify to this fact, and to prove the novelty of the invention at the date of the patent. Among whom, the evidence of Mr. Walker, an eminent manufacturer, connected with the wool trade for upwards of 30 years, was greatly relied on.

Sir F. Kelly, on the part of the defendant, defined the subject of the plaintiff's patent to be, the combination of the graduated

working comb with the circular holding comb; and this it was not pretended that the defendant had done. The construction of the defendant's combs were essentially different from Donisthorpe's; as was also their operation. Instead of being of different pitch at their opposite extremities, by a gradual change of pitch, diverging from coarse to fine, as was the case with the plaintiff's, the defendant's combs were of uniform pitch from end to end; but he availed himself of the practice which had been in vogue for combing wool long anterior to Donisthorpe's patent, and caused a coarse pitch of comb first to act on the material; then succeeded a finer comb; and so on, as in the old hand-combing operation. The use of this succession of different gauges of teeth is self-evident to any person desirous of combing out an entangled mass, and had been practised from time immemorial; it was not, therefore, such a thing as could form the subject of a valid patent. The means of effecting the operation might be new and legitimately claimed; but it would be obvious, on a comparison of the defendant's and plaintiff's machines (models of which were produced in court), that the means in the two cases were very different. He would also shew, that combs, such as that claimed by the plaintiff, were well known, and in common use for combing flax; and that, therefore, the plaintiff could not be entitled to the exclusive use of this comb for combing another kind of staple. Indeed, this comb, as he should shew, had been used for combing wool, by Mr. Anderton, before the date of Donisthorpe's patent. If, then, there was really any novelty of invention included in this patent, it must be the combination he had described, which it was not pretended the defendant had used. Again, there was a specific claim made for the use of rollers having an axle at one end only, which he should shew was old, and had been used by several manufacturers down to the present time. In support of the defendant's case, Mr. Fothergill, consulting engineer, was called, who explained the nature of the two machines, shewing that, in Donisthorpe's, the wool was lashed on to the holding comb; but that, in Heilmann's, there was no such action. He did not consider the combination of a straight and circular comb new. Hawksley had improved Cartwright's machine in 1793; it was a working comb striking into a circular comb. In 1826, Messrs. Busk and Westley heckled flax with graduated combs;—the combs were mounted on radial arms, and were of different pitch; but each was of uniform gauge throughout. Messrs. Lawson and Walker also used heckles like those of Busk and Walker. In Mr. Anderton's patent of 1826, for combing and dressing wool, there were combs of different pitch. He, the witness, when engaged with Messrs. Sharp and Roberts, made combs for heckling machines, like the plaintiff's, in 1835; and, before 1842, from 3 to 4000 were sent out. Mr. Joseph Swaile, flax-spinner, deposed that, in 1835, he commenced working graduated combs for combing flax and long hair; but that, in 1836, he ceased to operate on hair. Mr. G. Anderton,

worsted-spinner, in relation to his patent machine, said, that the working combs were of different pitch; he commenced working with two gradations of pitch; and, in 1832, added one more. From 1826, witness used different pitches of comb; and that the comb in Heilmann's machine is similar to that used by him in 1827;—witness's machines are in use at the present time. Mr. Sharp confirmed Mr. Fothergill's evidence relating to the construction of combs for flax machinery, with a graduation of pitch from coarse to fine; he also said, that they were alike applicable both for flax and wool; and likewise spoke to the difference between the plaintiff's and defendant's machines. Several other witnesses were called to prove the use of drawing-rollers, with an axis at one end only, before the date of plaintiff's patent.

Sir F. Theisiger having replied,

The learned Judge, deeming it unnecessary to recapitulate the evidence, briefly summed up the case for the jury. He said, that with respect to the fifth claim in Donisthorpe's specification, the objection raised on the defence could not be admitted; if the claim had gone for the use of rollers with an axis at one end only, the evidence would have set aside the case; but looking at the specification, the patentee says, I claim the application, not the use, of drawing-rollers; and I see no evidence to vitiate this claim. We now come to the first claim, which refers to the comb. There is evidence on both sides of great importance: first, was it new? Mr. Carpmael's, Mr. Whitehead's, and Mr. Walker's evidence go to prove this. On the other side, you have evidence which shews that the graduated gauge-comb was used for flax machinery. You will consider whether this is a new application when applied to wool combing machines. You will then consider whether, under Anderton's patent, the same thing was used. The next point is, whether there is an infringement of the plaintiff's patent. There may be an infringement if the defendant did not use the circular comb—this goes against Sir F. Kelly's point of law. You will then consider whether the defendant used the invention.

The jury, after a short absence from the court, brought in a verdict for the plaintiff.

HANCOCK v. BUNSEN.

February 13th.

This was an action for the alleged infringement by the defendant, as a partner in the Gutta-percha Company, of a patent obtained by the plaintiff on the 15th of May, 1844, for "certain improvements in cork and other stoppers, and a new composition or substance which may be used as a substitute for and in preference to cork; and a method or methods of manufacturing the new compositions or substances into bungs, stoppers, and other useful articles."

Sir F. Theigier, Mr. Serjeant Channel, and Mr. Webster, appeared for the plaintiff; and the Attorney-General, Mr. Bramwell, Mr. Lush, and Mr. Hindmarch, for the defendant.

Under this patent, it seems, that the plaintiff founded a claim to the exclusive manufacture of gutta-percha and its combination with ground cork and wood-dust, and also with India-rubber, for the purpose of manufacturing cork and other stoppers and useful articles. The pleas entered by the defendant denied the infringement, and impugned the validity of the patent, on the ground that the patentee was not in possession of the invention at the time he applied for his patent; and that his specification was calculated to mislead. In support of the plaintiff's case, several witnesses were called, to shew that Mr. Hancock was acquainted with the existence of the substance known as gutta-percha prior to the date of applying for his patent. Mr. Wishaw, late Secretary of the Society of Arts, deposed, that he had received, on behalf of the Society, specimens of gutta-percha, which had been sent from abroad by Dr. Montgomery, and, before the end of 1843, had given Mr. Hancock a specimen of the material,—knows his patent process, had seen it in operation, and was acquainted with his specification,—did not know gutta-percha had been similarly treated prior to the date of plaintiff's patent. The properties of India-rubber and gutta-percha were, in some respects, very different,—the former being very elastic, the latter but slightly elastic; the mastication or kneading of gutta-percha, to rid it of its impurities, could not be properly performed without the application of heat. It was applicable to purposes for which India-rubber could not be used; as, for instance, the manufacture of pipes; and, by the introduction of saw-dust into the kneaded mass, the gutta-percha acquired a greater degree of hardness than it naturally possessed. On cross-examination, the witness said, that one of the specimens he had received was in a fluid state, and that it required a chemical solvent to keep it in that state when the temperature was below 110°; for, at a lower temperature, if exposed to the atmosphere, it would solidify. The fact of Mr. Hancock having gutta-percha in his possession, both in the natural and artificial state, before March, 1844, was also spoken to by other witnesses,—one of whom saw plaintiff receive a specimen, towards the latter end of 1843, from a Mr. Mathews, connected with the house of Mackintosh and Co., but that he received it as a novelty. Mr. Cooper, the chemist, on being called, stated that gutta-percha was less adhesive than India-rubber, less heat was required to soften it, and the abstraction of heat rendered it more rigid than India-rubber. Both substances dissolved in the same solvents, but gutta-percha, if exposed to the air, would solidify. It has the property of resisting oils. He considered it was not obvious that gutta-percha and India-rubber would be susceptible of the same treatment. On cross-examination, witness said, he never saw gutta-percha in its natural fluid state,—if the specification said that the gutta-percha must be in its natural fluid state

when required to be operated upon, and it could not exist in that state, he thought the specification must be bad. Mr. Brand, the chemist, stated that he agreed, in every particular, with the last witness. Dr. Bachhoffner, of the Polytechnic Institute, confirmed the foregoing evidence in many respects, and proved, by a series of analytical experiments made on some articles purchased at the factory of the Gutta-percha Company, the presence of wood-dust, in combination with gutta-percha, as described in the plaintiff's specification. Witnesses (being servants of the Gutta-percha Company) were also called to prove the connection of the defendant, Mr. Bunsen, with that Company; but their evidence was by no means positive as to his connection with the works continuing up to the 10th June, 1851.

The Attorney-General, on behalf of the defendant, stated, that he should shew the jury that Hancock knew nothing of gutta-percha at the time of applying for his patent; for, according to a practice which was introduced by the Lord Chief Justice Campbell, when Attorney-General, the applicant for a patent, when opposed, was bound to lodge a description of his invention with one of the law officers of the Crown. This the plaintiff had done; and the document, which was called a deposit-paper, was dated January, 1843. In this document (a copy of which was produced) he does not mention gutta-percha: he says, two pieces of cork are to be cemented by India-rubber; and a composition is made up of ground cork, treacle, and glue, or India-rubber cement, for the production of a substance for working up into corks and bungs. It appears, from the evidence, that only two small pieces of gutta-percha can be proved to have been in the possession of Mr. Hancock prior to the date of his patent; and that in August, 1844, he was applying, through a friend, to Dr. Montgomery for information respecting the nature of that substance. It is impossible, therefore, to believe that, with these specimens, he could make such experiments as would inform him with respect to the nature of gutta-percha, or of the uses to which it might be applied. It is possible he might have made a guess as to the probable importance of gutta-percha in the arts; and that he, for that reason, delayed the sealing of his patent far beyond the usual period; but, even on enrolling his specification, it is certain that he was ignorant of one important characteristic of that substance; for that document contained two fatal mistakes relating thereto, viz., that it was not elastic; and that it might be used in its native liquid state. His specification also goes beyond the title of his patent, which is a further ground of vitiating the patent. But, so far from supposing that, by this patent, he had secured to himself the exclusive right of manufacturing gutta-percha, he proceeded to take patent after patent; and obtained for the sale of these rights upwards of £20,000. In April, 1845, he entered into an agreement with Mr. Bewley, himself an inventor of some improvements in stoppers, transferring to him the sole right to manufacture corks, under a patent

which was granted subsequently to the one now in question ; and, about this time, in a letter addressed to Mr. Bewley, he stated, in allusion to some proceedings which he had taken for obtaining a new patent, that "I have just returned from laying the foundation for the gutta-percha patent ;" thereby shewing that he, the plaintiff, had not, in 1845, a notion that the patent of 1844 gave him an exclusive right to the manufacture of gutta-percha. An agreement was also made, bearing date April 5th, 1845, between the plaintiff, Mr. Bewley, Mr. Nicholls (who had discovered the application of gutta-percha to bookbinding), and Mr. Keen (who proposed its application to the manufacture of boots and shoes), by which the interest in all patents obtained, or hereafter to be obtained, as the invention of the parties in question, for the application of gutta-percha to the manufacture of various articles (with the exception of that existing for corks) should belong, in equal moieties, to the contracting parties. But the plaintiff, not satisfied with the very large remuneration he had received, now wishes to destroy all the rights which have arisen from, or relate to, this agreement, by setting up the patent of which he still remains sole proprietor, and attempting to make it over-ride all the subsequent patents. For this purpose, he entered, in June, 1851, a disclaimer and memorandum of alteration to his specification, whereby he got rid of all the parts having no reference to gutta-percha ; and now comes into court with a patent referring exclusively to the treatment of gutta-percha, and its manufacture into bungs and stoppers,—which patent bears the early date of 1844. The learned gentleman then went on to say, that the effect of this disclaimer was to bar the plaintiff from claiming compensation, under his patent, for any act which might have been performed by the Gutta-percha Company prior to that date ; and, such being the case, he should merely put in evidence, that the defendant had withdrawn from the Company prior to the date of enrolment of the disclaimer. This having been done, the plaintiff was, consequently, nonsuited.

COURT OF EXCHEQUER.

(Before the Lord Chief Baron and a Special Jury.)

February 14th, 1852.

HARTLEY v. HOWLAND.

Mr. Knowles, Mr. Watson, Mr. Hindmarch, and Mr. D. Seymour, appeared for the plaintiff ; and the Attorney-General, Mr. Webster, and Mr. Gray, for the defendant.

This was an action for the infringement of a patent obtained by the plaintiff on the 7th of October, 1847, for "improvements in the manufacture of glass." * The design of this invention was to effect a saving in the manufacture of rough plate-glass, such as that used for the top lights of railway stations. This

* For description of this invention see Vol. 33, p. 266, Lond. Jour.

object the plaintiff attained by dispensing with the operation of ladling the molten metal into a cistern and heating it therein, and in lieu thereof ladling the metal direct from the pot on to the table, where it was rolled out in the ordinary manner: the annealing was then effected in the manner commonly practised in annealing crown and sheet glass. The ground of defence was, that a gentleman, named West, who had formerly held the factory which the defendant now holds, had, from March to May, 1835, made glass in the very same way in which the plaintiff now made it under his patent; that he abandoned that mode of working, as the Commissioners of Excise raised an objection to the glass so made, and he never afterwards resumed the process, as the Excise laws on glass were not repealed until after his bankruptcy. While he worked it, everybody who came into the factory could see the way it was done, and there were upwards of seventy men employed there. He became bankrupt in 1837; and after the defendant had taken the premises, he explained to him the process. The defendant then commenced a series of experiments for the purpose of discovering the best means of carrying out the operation, and it was not until the year 1850 that he succeeded. He was not, however, then aware of the plaintiff's patent for producing glass in the manner suggested by Mr. West.

On Mr. Knowles rising to address the jury, in reply upon the defendant's case, the Lord Chief Baron interrupted him, and said, that the question between the parties was so very simple and plain, that unless the jury differed upon the point which he would now put to them, there would be no necessity for any further time being spent in hearing the learned counsel address them in reply. The question he would put to the jury was this, did they think that what had been done by Mr. West—the predecessor of the present defendant—prior to the date of the plaintiff's patent, had been such a sufficient publication to the trade and to the world as to deprive the plaintiff of the novelty of the invention for which he had taken out a patent.

The jury, after a short consultation, returned a verdict for the plaintiff, with the nominal damages of 40s.

List of Patents

That have passed the Great Seal of IRELAND, from the 17th January to the 17th February, 1852, inclusive.

To Edwin Rose, of Manchester, in the county of Lancaster engineer, for certain improvements in boilers for generating steam.—Sealed 6th February.

Alexander Hidéard, of 25, Rue Taitbout, Paris, France, Gent., for improvements in propelling and navigating ships, boats,
VOL. XL. 2 F

and vessels, by steam and other motive power.—Sealed 10th February.

John Livesey, of New Lenton, Nottingham, draughtsman, for improvements in the manufacture of textile fabrics, and in machinery for producing the same.—Sealed 10th February.

Frederick Rosenborg, of the Albany, in the county of Middlesex, Esq., for improvements in the manufacture of casks, barrels, and other like articles, and the machinery employed therein.—Sealed 10th February.

Charles James Pownall, of Addison-road, in the county of Middlesex, Gent., for improvements in the preparation and treatment of flax, and other like fibrous vegetable substances.—Sealed 11th February.

List of Patents

Granted for SCOTLAND, from the 22nd January to the 22nd February, 1852.

To Aimé Nicholas Derode, of No. 37, Rue St. Roch, Paris, for a certain process of uniting cast-iron to cast-iron, and to other metals, and for uniting other metals together.—Sealed 26th January.

George Torr, of the Chemical Works, Trunley's-lane, Rotherhithe, animal charcoal burner, for improvements in re-burning animal charcoal.—Sealed 26th January.

James Pillans Wilson and George Fergusson Wilson, both of Wandsworth, Surrey, for improvements in the preparation of wool for the manufacture of woollen and other fabrics, and in the process of obtaining materials to be used for that purpose, —being partly a communication.—Sealed 26th January.

Victor Lemoign, of Cette, Department of l'Hérault, France, for certain improvements in rotatory engines.—Sealed 26th January.

John Stopporton, of Douglas, Isle of Man, engineer, for certain improvements in propelling vessels; parts of which improvements are applicable to steam-engines and pumps. Sealed 28th January.

Joseph Stenson, of Northampton, engineer and iron manufacturer, for improvements in the manufacture of iron, and in the steam apparatus used therein; part or parts of which are also applicable to evaporative and motive purposes.—Sealed 30th January.

John Chatterton, of Birmingham, agent, for certain improvements in protecting insulated electro-telegraphic wires, and in the methods and machinery used for that purpose.—Sealed 30th January.

- Sydney Smith, of Nottingham, for improvements in indicating the height of water in steam-boilers.—Sealed 4th February.
- Francis Clark Monatis, of Earlstown, Berwickshire, builder, for an improved hydraulic syphon.—Sealed 4th February.
- George Duncan, of the New North-road, Hoxton, and Arthur Hutton, of the same place, for improvements in the manufacture of casks.—Sealed 6th February.
- George Collier, of Halifax, Yorkshire, mechanic, for improvements in the manufacture of carpets and other fabrics,—being partly a communication.—Sealed 10th February.
- Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, London, mechanical draughtsman, for improvements in the manufacture of pigments or paints,—being a communication.—Sealed 11th February.
- Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, Middlesex, mechanical draughtsman, for improvements in machinery for weaving coach-lace, Brussels tapestry, and velvet carpeting, and other pile fabrics,—being a communication.—Sealed 13th February.
- Charles Cowper, of 20, Southampton-buildings, Chancery-lane, London, for improvements in machinery for combing and preparing wool and other fibrous substances,—being a communication.—Sealed 13th February.
- James Anderson Young, of the firm of A. S. Young and Son, of 185, Buchanan-street, Glasgow, surgeon, for certain improvements in dental operations, and in apparatus or instruments to be used therein.—Sealed 16th February.
- Hermann Turck, of Broad-street-buildings, London, merchant, for improvements in the manufacture of rosin oil,—being a communication.—Sealed 18th February.
- James Robertson, of Oxford-street, Manchester, chemist, for improved methods of producing or obtaining printing dyes and other substances used in printing; which improvements in whole or in part are applicable to other like useful purposes.—Sealed 20th February.

New Patents

SEALED IN ENGLAND.

1852.

- To William Longmaid, of Beaumont-square, in the county of Middlesex, Gent., for improvements in obtaining gold. Sealed 30th January—6 months for enrolment.
- Owen Williams, of Stratford, in the county of Essex, engineer, for improvements in preparing compositions to be used in

railway and other structures in substitution of iron, wood, and stone,—being a communication. Sealed 31st January—6 months for inrolment.

Charles Cowper, of Southampton Buildings, Chancery-lane, in the county of Middlesex, for improvements in multiplying motion applicable to steam-engines, saw-mills, and other machinery in which an increase of velocity is required,—being a communication. Sealed 31st January—6 months for inrolment.

Martyn John Roberts, of Woodbank, Gerrard's Cross, in the county of Bucks, Esq., for improvements in agricultural instruments. Sealed 31st January—6 months for inrolment.

Alexander Hédiard, of 35, Rue Taitbout, Paris, France, Gent., for improvements in propelling and navigating ships, boats, and vessels, by steam and other motive power. Sealed 31st January—6 months for inrolment.

Joseph Haythorne Reed, late of the 17th Lancers, Harrow-road, in the county of Middlesex, Gent., for improvements in propelling vessels. Sealed 31st January—6 months for inrolment.

Richard Archibald Brooman, of the Firm of J. C. Robertson and Co., of Fleet-street, in the City of London, for improvements in the purification and decoloration of oils, and in the apparatus employed therein,—being a communication. Sealed 31st January—6 months for inrolment.

William Squire, of High Holborn, late of George-street, Euston-square, both in the county of Middlesex, piano-forte-maker, for improvements in the construction of piano-fortes. Sealed 31st January—6 months for inrolment.

Alfred Vincent Newton, of the Office of Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in machinery for weaving coach lace, Brussels tapestry, and velvet carpeting, and other pile fabrics,—being a communication. Sealed 31st January—6 months for inrolment.

Frederick Philip Thompson, of Water Works Chambers, Orange-street, Trafalgar-square, engineer and surveyor, for improvements in filtering and preserving water. Sealed 2nd February—6 months for inrolment.

George Spencer, of Lacey-terrace, Islington, engineer, for improvements in the springs of railway carriages, trucks, and waggons. Sealed 2nd February—6 months for inrolment.

Samuel Cunliffe Lister, and James Ambler, both of Manningham, in the parish of Bradford, in the county of York, manufacturers, for improvements in preparing and combing wool, and other fibrous materials. Sealed 2nd February—6 months for inrolment.

Emmanuel Charles Theodore Croutelle, manufacturer, of Rheims, in the French Republic, for certain improvements in machinery

or apparatus for preparing woollen threads, and other filamentous substances, for weaving. Sealed 3rd February—6 months for enrolment.

Robert Heskeith, of Wimpole-street, Saint Marylebone, in the county of Middlesex, for improvements in apparatus for reflecting light into rooms, and other parts of buildings and places. Sealed 3rd February—6 months for enrolment.

Peter Claussen, of Gresham-street, in the City of London, Gent., for improvements in the manufacture of saline and metallic compounds. Sealed 3rd February—6 months for enrolment.

George Torr, of the chemical works, Trunley's-lane, Rotherhithe, animal-charcoal-burner, for improvements in re-burning animal charcoal. Sealed 3rd February—6 months for enrolment.

John Feather, of Keighley, in the county of York, worsted spinner and manufacturer, and Jeremiah Driver, of the same place, iron and brass founder, for certain improvements in screws. Sealed 9th February—2 months for enrolment.

Auguste Neuburger, of No. 4, Rue Vivienne, Paris, France, lamp manufacturer, for certain improvements in lamps. Sealed 9th February—6 months for enrolment.

William Beckett Johnson, of Manchester, in the county of Lancaster, manager for Messrs. Ormerod and Son, engineers and iron-founders, for improvements in railways, and in apparatus for generating steam. Sealed 9th February—6 months for enrolment.

Sanders Trotman, of Clarendon-road, in the county of Middlesex, civil engineer, for improvements in fountains. Sealed 9th February—6 months for enrolment.

John Dennison, of the Firm of John Dennison and Son, of Halifax, in the county of York, and David Peel, of the same place, manufacturers, for an improved lubricating compound. Sealed 9th February—6 months for enrolment.

Ralph Errington Ridley, of Hexham, in the county of Northumberland, tanner, for improvements in cutting and reaping machines. Sealed 9th February—6 months for enrolment.

Martyn John Roberts, of Woodbank, Gerrards Cross, in the county of Buckingham, Esq., for improvements in galvanic batteries, and in obtaining chemical products therefrom. Sealed 10th February—6 months for enrolment.

John Smith Hulton, of Bolton-le-Moors, in the county of Lancaster, bleacher, and Joseph Musgrave, of the same place, engineer, for a certain improvement, or improvements, in apparatus used in the bleaching of yarns and goods. Sealed 12th February—6 months for enrolment.

Christian Schiele, of Oldham, in the county of Lancaster, machinist, for certain improvements in obtaining and applying motive power. Sealed 12th February—6 months for enrolment.

William Edward Newton, of the Office for Patents, Chancery-lane, in the county of Middlesex, civil engineer, for improve-

- ments in the heddles or harness of looms for weaving, and in the machinery for producing the same,—being a communication. Sealed 12th February—6 months for inrolment.
- John Stephens, of Kennington, in the county of Surrey, Esq., for improvements in obtaining and applying motive power. Sealed 12th February—6 months for inrolment.
- John Mollady, jun., of Denton, in the county of Lancaster, hat manufacturer, for certain improvements in machinery or apparatus for manufacturing hats or caps. Sealed 12th February—6 months for inrolment.
- Charles Louis Barbe, of Mulhouse, in the Republic of France, for improvements in the reproducing of drawings, and in the mode of obtaining designs to be principally used in the engraving surfaces for printing fabrics. Sealed 12th February—6 months for inrolment.
- Annet Gervoy, of Lyons, in France, director of the Lyons Railway, for means to prolong the durability of the rails on railways. Sealed 13th February—6 months for inrolment.
- Edmund Morewood, of Enfield, in the county of Middlesex, and George Rogers of the same place, for improvements in the manufacture, shaping, and coating of metals, and in the means of applying heat. Sealed 13th February—6 months for inrolment.
- Hermann Turck, of Broad-street Buildings, in the City of London, merchant, for improvements in the manufacture of rosin oil,—a communication. Sealed 14th February—6 months for inrolment.
- Arthur Wellington Callen, of Peckham, in the county of Surrey, Gent., and John Onions, of Southwark, in the county of Surrey, engineer and iron-founder, for improvements in the manufacture of certain parts of machinery used in paper-making, and certain parts of railways, railway, and other carriages. Sealed 14th February—6 months for inrolment.
- William Edward Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in the manufacture of coke, and in the application of the gaseous products arising therefrom to useful purposes,—being a communication. Sealed 23rd February—6 months for inrolment.
- Jean Theodore Coupier and Marie Amedee Charles Mellier, of Maidstone, in the county of Kent, Gent., for certain improvements in the manufacture of paper. Sealed 23rd February—6 months for inrolment.
- Charles Cowper, of Southampton-buildings, Chancery-lane, in the county of Middlesex, patent agent, for improvements in machinery for combing and preparing wool and other fibrous substances,—being a communication. Sealed 23rd February—6 months for inrolment.

- Samuel Banes, of Bethnal-green, in the county of Middlesex, master mariner, for certain improvements in apparatus to be applied to, or connected with, the cables of ships or other vessels when riding at anchor. Sealed 23rd February—6 months for enrolment.
- William Stirling Lacon, of Great Yarmouth, in the county of Norfolk, Gent., for improvements in the means of suspending ships' boats, and of lowering the same into the water. Sealed 23rd February—6 months for enrolment.
- James Pilling, of Rochdale, in the county of Lancaster, spinner and manufacturer, for certain improvements in looms for weaving. Sealed 23rd February—6 months for enrolment.
- William Walker, of Plymouth, in the county of Devon, commander in the Royal Navy, for a method or means of ascertaining and indicating the deviations or errors of the mariner's compass. Sealed 23rd February—6 months for enrolment.
- Richard Archibald Brooman, of the Firm of J. C. Robertson and Co., of Fleet-street, in the City of London, patent agent, for improvements in windmills,—being a communication. Sealed 23rd February—6 months for enrolment.
- Thomas Young Hall, of the town and county of Newcastle-upon-Tyne, coal-owner, and colliery-viewer, for improvements in screens for screening coal, and other substances requiring to be screened. Sealed 23rd February—6 months for enrolment.
- Samuel Boulton, of Manchester, agent, for improvements in the treatment of metallic ores, and certain salts and residuary matters; and in obtaining products therefrom. Sealed 23rd February—6 months for enrolment.
- Thomas Walker, of Birmingham, for improvements in steam-engines. Sealed 23rd February—6 months for enrolment.
- Alfred Charles Hobbs, of New York, in the United States of America, engineer, for certain improvements in the construction of locks and other fastenings. Sealed 23rd February—6 months for enrolment.
- Peter Armand Le Comte de Fontainemoreau, of South-street, Finsbury, London, for certain improvements in gas-burners,—being a communication. Sealed 23rd February—6 months for enrolment.
- Henry Bessemer, of Baxter House, Old St. Pancras-road, in the county of Middlesex, for improvements in expressing saccharine fluids, and in the manufacture, refining, and treating sugar. Sealed 24th February—6 months for enrolment.
- Russell Sturges, of 8, Bishopsgate-street, in the City of London, merchant, for improvements in weaving-looms. Sealed 25th February—6 months for enrolment.
-

CELESTIAL PHENOMENA FOR MARCH, 1852.

D. H. M.		D. H. M.	
1	Clock before the ☉ 12m. 31s.	17	Vesta, R. A., 23h. 20m. dec. 9.
—	☽ rises 11h. 54m. M.	—	1. S.
—	☽ pass mer. 8h. 15m. A.	—	Juno, R. A., 21h. 31m. dec. 7.
—	☽ sets 3h. 39m. M.	—	38. S.
—	Pallas greatest hel. lat. S.	—	Pallas, R. A., 4h. 15m. dec. 10.
2 4 16	♃'s third sat. will im.	—	36. S.
6 22	♂ in conj. with the ☽ diff. of dec.	—	Ceres, R. A., 6h. 23m. dec. 30.
	2. 56. N.	—	48. N.
3 22 19	♀ in the ascending node.	—	Jupiter, R. A., 15h. 8m. dec.
4	Occul. 37 Leonis, im 14h. 44m.	—	16. 32. S.
	em. 15h. 36m.	—	Saturn, R. A., 2h. 3m. dec. 10.
4 10 38	♂ stationary	—	13. N.
17 22	♂ in conj. with ♃ diff. of dec.	—	Uranus, R. A., 2h. 1m. dec. 11.
	1. 54. N.	—	50. N.
5	Clock before the ☉ 11m. 39s.	—	Mercury pass mer. 0h. 17m.
—	☽ rises 4h. 49m. A.	—	Venus pass mer. 2h. 32m.
—	☽ pass mer. Morn.	—	Mars pass mer. 8h. 10m.
—	☽ sets 6h. 39m. M.	—	Jupiter pass mer. 15h. 40m.
12 25	♂ greatest hel. lat. S.	—	Saturn pass mer. 2h. 22m.
6 4 30	♃'s first sat. will im.	—	Uranus pass mer. 2h. 20m.
5 30	Ecliptic oppo. or ☉ full moon	19	☉ enters Aries, spring com.
11 0	☽ in Perigee	20	Clock before the ☉ 7m. 32s.
8 11 48	♃'s second sat. will im.	—	☽ rises 6h. 30m. M.
16 41	♃ stationary	—	☽ pass mer. 0h. 4m. A.
9 14 26	♂ in conj. with vesta, diff. of dec.	—	☽ sets 5h. 48m. A.
	2. 33. N.	6 43	Ecliptic conj. or ☉ new moon
10	Clock before the ☉ 10m. 23s.	15 7	♂ in conj. with the ☽ diff. of dec.
—	☽ rises 11h. 54m. A.		4. 38. N.
—	☽ pass mer. 3h. 43m. M.	21 7 0	☽ in Apogee
—	☽ sets 8h. 43m. M.	22 2 46	♃'s first sat. will im.
4 16	♃ in conj. with the ☽ diff. of dec.	20 49	♂ in conj. with the ☽ diff. of dec
	2. 55. S.		4. 34. N.
12 8 29	☽ in ☐ or last quarter	23 6	♂ in conj. with the ☽ diff. of dec.
13	Occul. B.A.C., 6448, im. 17h. 28m.		2. 41. N.
	em. 18h. 14m.	23 4 55	♃'s second sat. will im.
14 2 35	♀ in conj. with ♃ diff. of dec.	19 16	♀ in conj. with the ☽ diff. of dec.
	1. 9. S.		5. 51. N.
15 6	♀ in conj. with ♂ diff. of dec.	24 12 8	♂ in the ascending node
	3. 3. S.	25	Clock before the ☉ 6m. 0s.
22 30	♂ in sup. conj. with the ☉	—	☽ rises 8h. 3m. M.
15 0 52	♃'s first sat. will im.	—	☽ pass mer. 3h. 35m. A.
15	Clock before the ☉ 9m. 0s.	—	☽ sets 11h. 18m. A.
—	☽ rises 4h. 13m. M.	27 5 13	Ceres in ☐ with the ☉
—	☽ pass mer. 8h. 14m. M.	28 8 50	☽ in ☐ or first quarter.
—	☽ sets 0h. 18m. A.	29 4 40	♃'s first sat. will im.
16 2 22	♃'s second sat. will im.	21 26	♂ in conj. with the ☽ diff. of dec.
17	Mercury, R. A., 23h. 58m. dec.		1. 30. N.
	1. 27. S.	30	Occul. 39, Cancr, im. 8h. 45m.
—	Venus, R. A., 2h. 13m. dec. 14.		em. 9h. 34m.
	15. N.	—	Occul. 40, Cancr, im. 8h. 45m.
—	Mars, R. A., 7h. 52m. dec. 24.		em. 9h. 42m.
	13. N.	20 19	♂ in Aphelion.

J. LEWTHWAITE, Rotherhithe.

THE
LONDON JOURNAL,
AND
REPERTORY
OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXLIV.

RECENT PATENTS.

To JOHN RANSOM ST. JOHN, of the city of New York, in the United States of America, engineer, for improvements in the construction of compasses and apparatus for ascertaining and registering the velocity of ships or vessels through the water.*—[Sealed 27th December, 1850.]

THIS invention relates, first, to improvements in the construction of the mariner's or other magnetic compass, whereby any variation or deflection of the magnetic needle from the magnetic meridian, if produced by local causes, may be at once seen, and the amount of such variation or deflection indicated and ascertained by merely inspecting the card; and, secondly, to certain novel arrangements of apparatus for ascertaining and indicating the rate or speed of ships or vessels. The patentee has shewn two different kinds of apparatus for effecting the latter purpose. The first of these, which is denominated an "aquatic velocimeter," is to be let down into the water under the vessel, through a hole in the bottom thereof, on one side of the keel. It consists, principally, of a fan-wheel, which is caused to rotate by the water passing by it, and, by means of gearing, to communicate motion to hands or indexes, adapted to a graduated dial-plate in the cabin or on the deck: so that, by an inspection of the dial-plate, not only the total distance run can be clearly seen, but also the speed or rate at which the vessel is then proceeding can be accurately ascertained. The second apparatus is an improved geared hand-log, whereby the length of line run out in a given time, and, consequently, the rate of speed of the

* An Exhibition Prize Medal was awarded to this invention

vessel, can be ascertained and registered in a more accurate manner than with the ordinary log.

It is well known that the magnetic needles of mariners' compasses are liable to be acted upon by local causes, and thereby to vary from the magnetic meridian, and thereby indicate erroneously; which, if not known at the time, may cause the master of a vessel (if trusting to his compass, and believing it to act correctly) to steer in a wrong direction, and, perhaps, unwittingly run into danger. Now, the object of the first part of this invention, is to indicate when any variation of the magnetic needle of the compass takes place from local causes, and to determine, on inspection, the amount of such variation or deflection; so that, by a simple calculation, the master can easily ascertain the true magnetic meridian; and the patentee therefore gives the name of "self-determining local variation compasses" to the instruments made upon his improved plan.

In Plate VII., fig. 1, is a plan view, and fig. 2, a sectional elevation of one of the improved compasses. 1, is the spindle or pin, to carry the cap 2, which sustains the ordinary compass card 3, and the main magnetic needle *a*, shewn by dotted lines in fig. 1. These parts are made as usual; but between the cap 2, and needle *a*, a cross-bar *b*, (shewn by dotted lines in fig. 1,) is fitted, under the common card; or it may be made to carry a circle of thin metal, on which the usual divisions of the compass may be marked; but in either case the ends of the bar *b*, are each fitted with a pin or spindle *c*, or *c*¹, that sustains a cap *d*, or *d*¹,—each cap carrying an index arm *f*, or *f*¹. The shorter end of each arm has a balance-weight 4, to keep the arm horizontal; and the ends of the bar *b*, are each fitted with a forked shield or keeper-piece 5, one tongue of which is secured beneath the bar *b*, while the other tongue turns inward, and over the caps *d*, or *d*¹, so as to keep them and the index arms *f*, or *f*¹, upon the pins *c*, or *c*¹. Beneath these caps and arms are fitted the auxiliary or satellite magnetic needles *e*, *e*¹. On the card, or on two metal arms, attached to or made with the bar *b*, (if a frame is used instead of a card, as before noticed,) are two graduated sectors *g*, *g*, the use of which will be presently described.

The main needle *a*, is to be properly and evenly hardened at each end, and is to have these as equally charged as possible, by giving each the needful number of touches with the proper poles of the inductive magnet. The position of the needle *a*, under the card or frame, in relation to the cardinal points, is to be the same as usual; and the best of even-grained

steel is to be used in making both the needle *a*, and the satellite needles. The auxiliary or satellite needles are to be placed with their centres as nearly as possible equidistant from the main centre and the centres of the poles of the main needle. They are to be about one-fifth of the length and about one-thirtieth part of the weight of the main needle, and are to be hardened and charged at the ends by the inductive magnet, precisely in the same manner as the main needle. The satellite needles and index arms *f*, and *f*¹, with the caps *d*, and *d*¹, are to be properly balanced on the pins *c*, *c*¹, before these needles are charged by the inductive magnet. For adjusting the magnetizing of the satellite needles, the main needle, when duly charged, must be laid and kept in the magnetic meridian until the satellites are charged; and this charging is to be effected by touching them with the proper poles of the inductive magnet a sufficient number of times to make them stand parallel to the main needle, with the north pole of each satellite needle toward the south pole of the main needle, and *vice versa*; and, to make them work true, the charge must be increased or diminished, as may be found needful, during the progress of the operation. If, for instance, the north pole of either satellite be too weak, it must be touched by the south pole of the inductive magnet. If, after that, it be too strong, the south pole of the satellite must be touched with the north pole of the inductive magnet. If both poles become too strong for the proper effect above described, either may be weakened by touching it with the similar pole of the inductive magnet. To avoid this, the first charge of the satellites should be quite weak, to admit of strengthening up to the point of equal relation to a position with the main needle and the zero points of the sector scales; and care should be taken not to give the satellites a maximum charge at first. This process requires great care, attention, and patience, and should not be hurried, as it is not possible to foretell the number of touches needful; because there is no means to measure the amount of susceptibility to the influence of the main needle, which the first touch of the inductive magnet may give to the satellite; nor can the increase or diminution of this susceptibility by any subsequent touch be foreknown: therefore the process must be patiently followed until the satellites stand parallel to the main needle,—when the index arms *f*, and *f*¹, standing at right angles to the satellites, will be in the same line, or in the equator of the compass card or frame, at the point marked *o*, which is the zero of each sector scale *g*, and is the point of no variation of the main needle *a*.

The satellites being thus equally charged and adjusted, the sector scales g , are then to be graduated as follows:—The curved lines of the scale being marked on the card or frame, from the pins c, c^1 , as centres, at the northern extremity of the sector-scale line, on the east side, place the letter E, and on the southern extremity the letter W; and then, at the northern extremity of the sector scale, on the west side, place W, and at the other end E. With the zero o , in the equator of the card, and under the points of the index arms f, f^1 , move the main needle one degree, either east or west of the true meridian, and let it lie there. When the satellites have settled perfectly still, make a point-mark on the line of the scale, under the point of each index arm; this done, move the main needle one degree over and past the magnetic meridian the other way; and when the satellites have become perfectly still, mark under the index arms, as in the first case. Proceed thus, alternately, until the scales are marked, each way, as high as the satellites will work before they turn back or stand still, when the main needle is moved forward either way: this will depend entirely on the susceptibility of the needles; for which reason it will be almost impossible to make two sector scales alike for different needles, and rarely or never beyond ninety degrees; though a full circuit of the satellites may be made by adjusting them with a light charge, or at a sufficient distance to have their poles reversed from the above process, or pointing in the same direction as the poles of the main needle. With the first-described arrangement, and charging of the satellites, when the main needle passes 90° from the magnetic north either way, the satellites and index arms will begin to return upon their scales, as the main needle continues to vary and leave the magnetic meridian beyond 90° ; but they will both stand at o , when the north pole of the needle is made to point due magnetic south, and thence up to 90° . On the main needle returning, the satellites, with the index arms, will proceed upon the sector scales; and from 90° to due magnetic north, they will gradually return to o , when the main needle arrives in the magnetic meridian.

It will be understood, from the foregoing description, that the marks E, indicate easterly variations, and the marks W, westerly variations, according to the direction to which the arms f, f^1 , tend from their respective zero points; and the amount of this variation either way, under all ordinary causes, with usual protection to the compass, will be ascertained as follows:—When there is no variation from local causes, the

index arms will each be over its respective zero *o*; but when the satellites vary, so that each index arm points to any given number of degrees on its sector scale, add the two amounts together; and the half of this sum will be the amount of the actual variation, either *E*, or *W*, produced by local causes. If both indexes shall be either north or south of the equator or zero, between the east and west points of the sectors, subtract the less from the greater angle; and the balance will be the variation of the main needle from the magnetic meridian, in the direction shewn by the greater angle. Such a circumstance will indicate the existence of some unusual or extraordinary disturbing cause in the vicinity of the compass, either at the north or south side, in whichever direction the pointers may incline.

The patentee claims, as the first part of his invention, the application of satellites or auxiliary needles to the magnetic compass,—such needles being prepared, applied, and adjusted in the manner and for the purposes above described; including any merely mechanical variations that shall be actual equivalents of the means employed, and substantially the same as applied by him for the purposes above set forth.

The mechanical arrangements of the aquatic velocimeter present the following advantages:—first, the means of fixing the mechanism in its place, detaching the same at will, and refixing it again, without reference to the then situation of the ship; secondly, denoting and registering, with accuracy, the number of miles or knots the ship has run through the water; thirdly, the means of so detaching the working parts from the register that the latter shall not operate when the ship is at anchor in a tideway; and, fourthly, fitting the acting parts, so that they are protected from the effects of any vertical motion, either of the ship or the water.

Fig. 3, represents an elevation of the velocimeter-wheel, and a section of the pipe enclosing the connection to the recording clock-work, the registering face of which is also shewn in this figure; fig. 4, is a section of the clock-work, and a side elevation of the velocimeter-wheel; fig. 5, is a front elevation of the clock-work, with the recording face removed; and fig. 6, is a plan of the pipe and parts near the velocimeter-wheel. *A*, is a pipe (of any suitable metal), commencing from the deck, or from any convenient point above the water-line, in a perpendicular position, in the ship, and prolonged downwards, so as to terminate with a water-tight joint on the outside of the ship's bottom. In the inside of the orifice of the pipe *A*, there is a strong bead or flange *i*,

that serves as a seat for a circular metal plate *a*, which prevents any indirect current of water into or from the tube *A*; and above it is an upper frame *b, b*, the sides of which have grooves 2, 2, (see figs. 4, and 6,) to receive ribs 3, on each side, that extend the whole length of the pipe *A*: these ribs and grooves are set fore and aft of the ship, and guide the apparatus into or out of its place,—the cross-piece 4, of the frame *b*, having a rope, rod, or chain *s*, by which the whole frame is lowered or raised. Below the orifice, the plate *a*, has two hanging standards *c, c*, and a foot-piece *c'*, which, with the frame *b*, are made in one piece with the plate *a*. Between the standards *c, c*, two screw-centres *e, e*, carry the ends of the principal shaft or arbor *d*, on which are set eight paddle-blades *B*: these are not placed parallel with the axis, but at such an angle of deflexion, in proportion to their length, that a progress of about three feet in a direct line through the water shall give the blades *B*, exactly one complete rotation, and no more. At *e, e*, two flanges, cast solid with one of the standards *c*, form the top and bottom of a box, which is enclosed with a strip of metal, screwed on the sides of the standard, and has a hole to receive the shaft *d*, of the fan-wheel. On the shaft *d*, within the box, is fitted a single-thread worm-wheel 7, that gears into a corresponding horizontal toothed wheel *f*, (fig. 4,) with forty teeth. The top of the spindle of this wheel *f*, is made square, and takes into a socket in the lower end of a short vertical arbor 10, that passes through the top of the box *e*, and through the plate *a*; beneath which there is a set-collar *g*, secured by a pin 11, to keep the shaft 10, from rising off the spindle of the wheel *f*. Above the plate *a*, is a pin 12, that is passed through the arbor 10, and through a slot in a socket *h*, at the lower end of a vertical rod *i*; and this rod is prolonged up through the tube *A*, and finishes at the top with a square key-socket 13, which receives the square end of a short arbor *k*, set in a frame 14, fixed in the lower part of the clock-work case *c*. The arbor *k*, carries a pinion *l*, of 12 teeth, gearing into a wheel *m*, of 66 teeth, set on a spindle 15, which passes through the upper plate of the frame 14, and finishes with a short square portion, having a round end above it: these parts receive the socket-piece 16, of the coupling-rod *n*, which is fitted to the top of the spindle 15, so that the rod *n*, may be just lifted and turned to set the register-hands above, and yet not be entirely detached from the spindle 15. The top of the rod *n*, is formed as a socket, so that the lower end of the first clock-work arbor *p*, may be attached or detached at pleasure. Above this the

back-plate *q*, of the clock-frame is lengthened down with two bracket-pieces *18*, through which the rod *p*, passes, receiving on its top the bevelled runner-pinion *r*, of 10 teeth, fitted to gear into the bevelled wheel *s*, of 60 teeth, set on an arbor *19*; which arbor bears against the plate *q*, and carries the next pinion, and the canon pinion, and the tubes between that and the face; and outside the face it carries the hand *21*, for counting rods, yards, or any other unit of measurement. Next the wheel *s*, a pinion of 8 teeth is made with the arbor *19*, and gears into the wheel *t*, of 80 teeth, fixed on an arbor above, which also carries a pinion of 8 teeth, that gears into a wheel *v*, of 80 teeth on the canon arbor: this arbor passes through the clock-face, and terminates just within the point of the arbor *19*, and carries the hand *22*, which counts miles up to 100 in number. The canon arbor is fitted with a pinion of 16 teeth, gearing into a wheel *w*, of 80 teeth, which rotates freely on the arbor of the wheel *t*, and has its nave *x*, formed as a pinion of 30 teeth, to gear into a wheel *u*, of 60 teeth, set on the second canon arbor: this arbor goes through the face just short of the first canon arbor, and carries the hand *23*, which counts miles up to 1000. *y*, is the dial-plate, with three sets of divisions; *z*, is the frame, which carries the glass over the dial; and at *24*, there is an opening, closed by a door, by means of which the fingers can be introduced to reach the socket *16*, to set the hands in unity at the time the ship is taking a departure, without removing the glass and frame *z*, or touching the hands.

To make a water-tight joint at the bottom of the vessel, the lower part of the tube *A*, may be made separate from the continuous part above, in the manner shewn at fig. 7, which is a section at a right angle to fig. 3, and shews a pipe, with a flange *s*, below the outside planking of the ship, and the pipe *A*, coming above the inside planking, where a screw-thread is cut on it to take a union nut *9*; the lower part of which nut has an external flange to take the inner planking, and the upper part an internal flange, to overlies the screwed part of the pipe, and bear upon a flange, turned outward on the lower end of the next upper length of pipe, between the inner flange of the nut *9*, and the top of the screwed part; so that the outer flange *s*, is held firmly against the outer planks, and the two lengths of pipe *A*, are held firmly together by the same connexion or union screw. In this figure the rib *3*, is shewn only in that part of the pipe which goes through the bottom of the ship, and it is tapered at the top, so as to enter the grooves *2, 2*, in the sides of the frames *b, b*, without it

being necessary to have ribs in the upper part of the tube; for the frame *b*, when lowered by a rod or bar, can be so directed as to place the grooves over the tapered tops of the ribs, which, entering the grooves in the descent, will guide the mechanism into its place.

The operation and timing of the parts, and the proportions of the gearing being stated, it will be seen that, the paddle-blades *B*, being set at a proper angle with the axis on which they rotate, the motion of the vessel through the water will cause the blades *B*, to rotate, and, by means of the intermediate gearing, to make the hands move in front of the dial, and indicate the distance the vessel has run. It will be understood that the distance run in a given time may be ascertained by comparing the hands on the dial with a clock or watch; thus practically giving the rate of the ship, in miles, per hour, by mere inspection.

The patentee does not limit himself to the stated extent of the numerical registry—to the sizes and proportions of the parts and gearings—or to the mode shewn of fitting the moving parts. What he claims is, the attaching the discs or plates *a*, to the sliding-frames *b*, and *c*, (which frame *c*, carries the shaft *d*, of the paddle-blades *B*,) when the said frames and plates are fitted to be lowered into, or raised out of, a tube *A*, in such a manner that, when in place for use, the plate *a*, may prevent any indirect current of water from ascending into, or descending out of, the tube *A*, and thus disturb or destroy the accuracy of the instrument;—the paddle-blades *B*, by this improvement, being subject only to the direct action of the vessel's progress through the water, as described and shewn.

The improvements in the hand-log embrace a novel combination of mechanical movements with the common log-reel, and the attachment to the log-line of a mechanical substitute for the common "log-ship," or piece of wood at the end of the line: whereby the length of log-line run out in any given time is registered, and the rate of speed accurately ascertained. Fig. 8, is an elevation of the improved geared hand-log; fig. 9, is a section through the line *A*, *B*, of fig. 8; and fig. 10, is a plan view, with the dial-plate and glass removed, to shew the internal positions of the operative parts under the dial-plate. Fig. 11, is a sectional elevation of the substitute for the common log-ship, which is similar in form to a small parachute or strong parasol; but it is called, by the patentee, the log-ship, to identify it with the use to which it is applied; and it is represented in this figure as if in operation. Fig. 12,

also represents the log-ship, but with the becket ferrule detached, as described hereafter, and the log-ship folded, as while being drawn on board after use.

c, is the main frame of metal, with handles *d*, and *e*. On the upper and outer corner of the handle *e*, is a pivot 1, carrying a twelve-second log-glass *r*, made in the usual manner. *a*, is a shaft, sustained by centre-screws 2, 2, which pass through the sides of the frame, and enter sockets in the ends,—so that any looseness or unusual strain shall not disengage the shaft *a*. *x, x*, are two flanges, cast solid with the shaft *a*, and turned and fitted to receive the heads *b, b*, between which the trundle-staves 3, 3, extend,—the whole forming the reel *c*, for the log-line 4. At *s, s*, two pieces, to form the top and bottom of a box *h*, are cast or made with one side of the frame *c*, between that and the log-reel, and enclosed with a strip of metal, screwed at the ends, with an opening through which the shaft *a*, passes. The end of the shaft *a*, within the box *h*, is formed as a worm-wheel *c*, which gears into a wheel *d*, having 55 teeth, and set on an arbor 5. The upper end of this arbor is prolonged through the top *e*, of the box *h*, and terminates in a squared top, inside the index or dial-box 1, where it receives the pinion *e*, the teeth of which are bevilled outwards and downwards; and within the teeth, on the under-side, is formed a collar, that lies in a recess in the head of the governing-lever *g*. This lever is formed with an eye, to lie round the arbor 5, and turns on a fulcrum at 11, in the side of the box 1. Between the arbor 5, and fulcrum 11, a spring *h*, overlies the lever *g*, and keeps it down and the pinion *e*, at the lowest point on the arbor 5,—except when the outer scale-formed end 12, of the lever *g*, is depressed, as hereafter described. Within the box 1, is mounted the arbor 7, that carries the counter-wheel *f*, which is made with teeth bevilling outwards and upwards, to gear fair with the teeth in the pinion *e*, when that is raised on the arbor 5, by depressing the outer end of the lever *g*. The top of the arbor 7, is drilled to received a button-topped pin, coming down through the glass 13, for the purpose of setting the index-pointer or hand 9, which overlies the index-card 10.

In figs. 11, and 12, *p*, is the top of a hollow tube or handle *k*, having a circular set of fixed points 15, to which are connected the top ends of the stretcher-pieces *l*, and these are connected by stretcher-pieces 16, to the joints 17, of the tube *m*, which slides loosely on the hollow tube *k*. A tube *n*, also slides on the staff *k*, and enters the lower end of the tube *m*, between that and the tube *k*, at the point 18 (see the enlarged

sectional view, fig. 13,); it is made slightly conical, to hold well between the tubes *m*, and *k*, like a circular wedge, yet start easily by a jerk; and it has two eyes 19, to which the ends of a piece of log-line *o*, are connected. At the bight 20, of the line *o*, the end of the log-line 4, is attached, as also one end of the stray and draw-home line 21; and the other end of this line 21, is fastened to an eye 22, on the prolongation *p*, of the tube *k*, above the joints 15. *q, q*, are the external edges of the covering on the stretchers *l, l*: which covering may be made of thick sheeting, linen, or light sail duck, or any suitable material, and varnished. At *r*, is a small portion of lead, sewed into the inside, near or on one end of the stretchers *l*; and exactly opposite, at *s*, a portion of cork is attached.

It is intended that one man shall hold the reel in both hands, so that the right thumb shall readily press on the scale-piece on the end of the lever *g*,—the log-glass *r*, being sustained by the pivot 1, in the situation shewn by dotted lines in fig. 8, directly over the forefinger of the man, who sees that the index-pointer 9, is at zero of the scale on the index-card, and the sand all in the bottom of the log-glass. The conical tube *n*, is pushed in between the tubes *k*, and *m*, so as to hold all the parts expanded, as in fig. 11, before throwing; then a second man throws the log-ship, with a sufficiency of stray line to reach the water and allow the motion of the vessel to draw the log-line taught, when the log-ship will take the proper position in the water; and the man holding the reel now instantly turns the log-glass *r*, over with his forefinger (so that it takes the position shewn in fig. 8, by the full lines), and at the same moment presses down the scale 12, at the outer end of the lever *g*, so as to raise the inner end of the lever, and thereby put the pinion *e*, into gear with the counter-wheel *f*. The log-line 4, running off, and rotating the reel, puts all the parts in motion; and the log man, keeping all steady, watches the log-glass until the sand has run out. He then immediately turns the glass with his forefinger; and the keeper-spring *h*, instantly depresses the lever *g*, and takes the pinion *e*, down out of gear with the counter-wheel *f*, which stops directly—leaving the hand 9, at the point it had reached on the index-card 10, at the time the sand in the log-glass had run out. This will denote the rate per hour, in miles and fractions, at which the ship or vessel has moved through the water during the twelve seconds occupied by the sand running in the log-glass. The second man now “hauls home” on the log-line;—this jerks the tube *w*, from between the tubes *k*, and *m*, and off the handle *k*; leaving the log-ship *x*,

to turn end for end, and at liberty to fold together, as it is shewn at fig. 12, with the stay-line 21, taking the connection to the log-line 4, by which it is drawn on board the vessel as the line is wound on to the reel, as usually practised.

With the gearing, above described, between the log-reel and the index and glass, the length of the stray-line at the commencement or termination of the operation is of no consequence. For, if the lever *g*, is depressed at the same instant the glass *r*, is turned, the log-ship, having hold in the water, runs off a given length of line in the twelve seconds; and the lever being set free by the log-man at the instant the sand has run down, the length of log-line run off in the time (moving the gearing as it runs off) gives the rate per hour, independent of what line has run off before the glass is turned to commence running the sand, and equally independent of what log-line may run out after the sand has run down—provided the log-man lets go the lever *g*, as the last sand descends; as then all the line that runs off the reel afterwards, has not any effect on the gearing and recording parts of the machine; so that these parts, beginning and ending their work with the run of the sand in the log-glass, denote the rate of the ship by mechanical means, acting with mathematical accuracy.

The patentee does not confine himself to the mode described and shewn of arranging the gearing to a twelve-second log-glass, but reserves the right to vary both the glass and the gearing, by calculating the gearing to suit the glass (whether running a greater or less number of seconds), so as to obtain the same result,—namely, a mathematical measure of a ship's speed through the water, by the application of similar mechanical means to the common log-reel and line already in use, and employed with a more mechanically effective log-ship, such as herein described: which log-ship has both a larger spread and deeper hold in the water, with a concave face acting against the water, whereby any lateral escape of the water is very much lessened, if not entirely prevented, and the log-ship remains so nearly stationary, while in use, that the effect of the pull on the line, by the motion of the vessel, does not cause any material error in counting the rate of the vessel's speed. In case of accident to the mechanism, the log-reel may still be used with a line marked in knots in the usual manner, either with the parachute or the common log now in use.

Under this head of the invention, the patentee claims, First,—the arrangement of the log-glass *r*, lever *g*, pinion *e*, and wheel *f*, whereby the motion given to the clock-work by the reel *g*, is communicated to the index *s*, during a definite

period of time; the parts being so proportioned and the dial so divided, that the index, moving while the sand is running in the log-glass *r*, shews the rate of speed at which the vessel is moving per hour of time during twelve seconds or any other known time; and the parts being arranged and operated on substantially as described, or in a manner equivalent to produce the same results by the like means. Secondly,—the application of a parachute *κ*, to the purpose of a log-ship, and the combination therewith of the cylindrical wedge *n*, or its equivalent, to enter between the tubes *k*, and *m*, to keep the log-ship *κ*, spread when in the water, and disengaged when hauled in to “fetch home;” so that the log-ship closes and turns end for end in the water, and is easily hauled on board,—the said log-ship being used with the reel and registering parts above described and shewn, or with any other means of supplying and determining the amount of log-line run out during a known period of time.—[Inrolled June, 1851.]

To JOHN WALTERS, of Sheffield, manufacturer, for improvements in knives and forks.—[Sealed 21st August, 1851.]

THIS invention relates to certain improvements in the construction of knives and forks; the principal object of which is to obtain the necessary “balance” of the handle without the use of lead, as employed in the ordinary balance-handle cutlery. It has been the practice, as is well known, to make the handle balance the blade or prongs of the knife or fork, by introducing lead into the cavity formed for the reception of the “tang” or piece of iron that serves to secure the blade or prongs to the handle; and, in consequence of the space occupied by the lead, the length of the tang is so much reduced, that it forms but an insecure means of attaching one part to the other. Now, as in knives and forks constructed according to this invention, the use of lead is dispensed with, the tang may therefore extend to nearly the whole length of the handle. The blade is partly balanced by the extension of the tang; but, in order to cause the handle to preponderate, the “bolster” is extended in length from the shoulder, so as, by its increased weight, to produce the required effect; and the bolster is formed without those angles which, in knives and forks of the ordinary construction, serve to collect and retain the dirt.

In Plate VII., fig. 1, is a sectional plan view, and fig. 2, an edge view of one of the improved knives; and fig. 3, is

an under side view, and fig. 4, an edge view of an improved fork. The ivory handle *a*, is secured to the tang *b*, by the ordinary composition; and it will be seen in figs. 1, and 4, that the tang extends nearly the whole length of the handle. The bolster *c*, is of an oval form in the transverse section, and it extends in gradual curves from the shoulder *d*, so as not to form any angles therewith: any other sectional form that may be preferred may be substituted for the oval one. Although the bolster is represented as made in one piece with the blade or prongs and tang, this is not necessarily the case; for the patentee proposes sometimes to form the bolster of another metal,—say, for example, German silver. In this case, the blade and tang are made of one piece of steel, and the bolster (which is formed with a hole through it to receive the tang) is fitted close up to the shoulder, and permanently secured thereto by soldering or other suitable means. Sometimes, in order to render this improved cutlery more ornamental, the bolster is coated or covered with silver or gold, by the ordinary process of electro-plating. In the manufacture of silver dessert knives and forks, the blade or prongs and bolster are formed of one solid piece of metal; and the tang, which may be of inferior metal, is fixed permanently into the bolster.

The patentee says, he is aware that the common descriptions of knives and forks have been made with long tangs, and without the use of lead, but that the handles of such cutlery have not the property of balancing the blade. He claims, as his invention, the lengthened bolster *c*, and tang *b*, for knives and forks, whereby to produce the balance or preponderance of the handle; also, electro-plating or coating the bolsters of knives and forks, as above described.—[*Enrolled February, 1852.*]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in machinery for cutting files,—being a communication.—[Sealed 23rd July, 1850.]

THIS invention consists in the improved arrangement of machinery for cutting files which is represented in Plate VIII.

Files are usually made of a form presenting four faces, which are more or less curved, and slightly swelling from the handle towards the middle, and decreasing in a more sudden curve towards the point. These curves, as the file passes

under the cutter, necessarily vary the range of its motion in cutting,—the motion being greatest where the file is thinnest and narrowest, so that the force of the blow is greatest where it should be the least: hence the teeth will be cut deeper towards the point than at or towards the middle. Again, the two ranges of teeth cross each other at given angles to the axis of the file; and the motion of the cutter must be diagonal to the general plane of the face of the file, to make the teeth pointing towards the nip or point of the file. These peculiarities in the form of the body and the teeth present serious practical difficulties in the making of files by machinery. If the cutting-edge be made as it should be, viz., at right angles to the plane of its motion, it will be in the right position to cut one range of teeth; but when the cutting-edge is reversed, it will then be oblique to the face of the file, and only touch it at one edge: hence, such an arrangement is impracticable. If the cutting-edge be made diagonal to the plane of its motion, and reversed for the second range of teeth, then the plane of motion of the cutter will be diagonal, and the force of the blow will be greatest on one side in cutting one range of teeth, and greatest on the other in cutting the other range,—the result of which must necessarily be an imperfect file. Finally, the curve of the face and the line of the ranges of teeth being diagonal to the axis of the file, the relations of the cutting-edge to the plane of the face to be cut, slightly vary, as the file moves under the cutter from the point to the handle; and from this it must follow, that if the edge of the cutter and the face of the file be not made to shift as the file passes under the cutter, the cuts will vary, and the teeth produced will be uneven.

To obviate the above difficulties is the object of this invention, which consists, first, in shifting the line of motion of the feeding-carriage or the plane of the file for the cutting of the second range of teeth on each face; so that, while the cutter retains the same position, the feeding motion of the carriage, in cutting the first range of teeth, shall be in a line diagonal to the face of the cutter; and, in cutting the second range of teeth, the said motion shall be in a line the reverse of the angle of the first; and thus the power applied, for cutting the teeth, will exert an equal force over the entire breadth of the file. Secondly, in connecting the cutter or chisel, or the stock thereof, with the slide, by which the power for cutting the teeth is applied, by means of a joint, the axis of which shall be at right angles, or nearly so, with the face of the cutter: whereby the cutting-edge is rendered capable

of adapting itself to the slight variations of the face of the file, as it passes under it, and also to any slight inequality in the texture of the metal to be cut. Thirdly, in regulating the force of the cut according to the surface of the metal to be operated on, by increasing or diminishing the tension of a spring, or the leverage of a weight (which acts on a slide to work the cutter), by means of a plane on the carriage, so formed as to give the required variation to the force applied.

Fig. 1, Plate VIII., is an end elevation of the improved machine; fig. 2, is a longitudinal vertical section; fig. 3, is a plan view thereof; and fig. 4, is a transverse section of the carriage and bed-piece. *a*, represents the bed-frame of the machine, to which is properly secured the upper frame-work *b*. The top of the bed-frame *a*, is formed with two ways or guide-rails *c, c*, on which runs a carriage *d*, provided at one end with a rocking-piece *e*, that slides vertically in a recess in the carriage. This rocking-piece has, on its under side, a semicircular groove, which is threaded to fit the threads of a feed-screw *f*, hung in journals between the two rails or ways *c, c*; and on the outer end of the shaft of the screw *f*, is a ratchet-wheel *g*, which is driven by a click or pall *h*, connected, by means of a stud or adjustable pin *i*, to an arm *j*, mounted on a rocking-shaft *k*. This rocking-shaft *k*, has another arm *l*, (fig. 3,) to which is jointed the lower end of a vertical rod *m*, that slides in a tube *n*, surrounded by a helical spring *o*. All these parts are shewn detached in the sectional view, fig 5. The spring *o*, rests, at its lower end, on a collar, and, at its upper end, bears against a pin *p*, that projects from the rod *m*, and slides in slots in the tube; so that the said spring always tends to force up the rod, and thus, by turning the shaft *k*, to draw back the click or pall *h*, which, at every revolution of the main shaft *q*, is pushed forward to turn the ratchet *g*, the required distance, according to the length of leverage of the connection of the pall with the arm of the rocking-shaft. This motion is effected by means of a cam *r*, on the main shaft, which, once in each rotation of the main shaft, acts on the upper end of the rod *m*, and, by depressing the rod, causes the shaft *k*, to turn in the opposite direction, and push forward the click *h*. In this way, at each rotation of the main shaft, the carriage is moved forward the distance required for the cutting of a tooth. At the end of the feeding motion, the carriage is moved back by the attendant, who, for this purpose, must first disengage the block *e*, which is secured, by a screw, passing through a slot, to the middle of a short lever *r*¹, connected with a hand-lever

r^2 , which extends to the front end of the carriage, so as to be within reach of the attendant. The bed of the carriage is lined with lead, to receive the piece of metal to be cut or formed into a file; the heel or stem of which is introduced into a slot in a piece s , and fixed therein by a temper-screw; and such piece s , is formed with journals or pivots at its ends, which turn in two bracket-pieces t, t , that project from a plate u , connected with the end of the carriage by the screws v, v : these screws pass through elongated holes or slots, so as to admit of being adjusted to the bed of the carriage. When cutting the edges of files, the carriage-bed should be made (as represented in longitudinal section at fig. 6, and in transverse section at fig. 7,) with moveable pieces w, w , which can be shifted according to the form and size of files to be cut, and thus form a solid and firm bed.

The cutter or chisel x , is formed with a stem, fitted and secured by a temper-screw y , in the socket of the lower half of a stock z , which is jointed to the upper half by a screw-bolt a^1 . The two halves of this stock are put together in the manner of the well-known rule-joint, so that the chisel or cutter shall have sufficient lateral play to adapt itself to the varying plane of the surface of the file. The upper end of the stock is fitted in a socket at the lower end of a heavy block of metal b^1 , called a slide, and is there secured by a temper-screw c^1 . The slide b^1 , is a quadrangular prism, of the requisite weight, and slides in two cross-bars d^1, d^1 , of the frame, each of which is made in two parts, connected together by screw-bolts e^1, e^1 , that they may be adjusted to the slide. The position of the slide is in a plane perpendicular to the transverse plane of the bed-frame, and inclines back from a line perpendicular to the longitudinal plane of the bed-frame, so as to give the inclined cut required to make the teeth of the file sharp towards the point thereof. At about the middle of its length, the slide is provided with a strap f^1 , properly secured to it, and furnished with two trunnions g^1, g^1 , on opposite sides, which play in the slots of two arms h^1, h^1 , of a rocking-shaft i^1 . The shaft i^1 , has its bearings in the upper frame b , and is provided with another arm j^1 , carrying at its outer end a roller k^1 ; which roller is forced down by the cam l^1 , on the shaft q , once in each rotation of such shaft; and thereby the slide b^1 , with its cutter or chisel, is lifted, after each blow upon the file.

The cam l^1 , has a greater sweep than the cam r , and begins to lift the slide and cutter before the cam r , begins to work the feed-motion; but so soon as the feed-motion is

completed, the cam l^1 , liberates the rocking-shaft, and thereby permits the slide and chisel to descend, and cut a tooth on the blank or file. As the rocking-shaft turns to lift the slide, a projecting-piece m^1 , is brought in contact with a spring n^1 , attached to another rocking-shaft o^1 , from which projects an arm p^1 , provided with a set-screw q^1 , the point whereof comes in contact with, and is arrested by an arm s^1 , of another rocking-shaft t^1 ; and this shaft t^1 , has another arm u^1 , provided with a roller v^1 , which runs on a plane w^1 , attached to and carried by the carriage d . After the arm p^1 , of the rocking-shaft o^1 , has been arrested, the continued upward motion of the slide gives tension to the spring n^1 ; and the recoil thereof aids in forcing down the slide to make the cut: therefore the point at which the rocking-shaft o^1 , is arrested, will determine the force with which the blow will be struck. The general force of the blows for various kinds of files is regulated by the set screw q^1 ; but the variation of this force for any one file is regulated by the plane w^1 , on which the roller v^1 runs: the lower the plane, the less tension the spring will receive, and hence the less will be the force of the blow, and *vice versa*. The form of the plane w^1 may be modified to suit the form of file to be cut, so that the force of the blow for cutting the teeth may be proportioned to the varying breadth of the file, and also to the varying distance of the surface of the file from the highest point of elevation of the cutting-edge.

The line of the cutting-edge of the cutter or chisel is directly across the frame; and the line of motion of the carriage is (as represented by the dotted line *, *, in fig. 3,) at the same angle to the line of the cutting-edge of the chisel as the axis of the file is to the first range of teeth. After one range of teeth has been cut on the two faces of the file, it is to be transferred to another machine, similar to the one above described,—except that the line of motion of the carriage relatively to the line of the cutting-edge of the chisel is reversed, so that the second range of teeth may cross the first. It is not, however, absolutely necessary that two machines should be employed; as all the ranges of teeth can be cut on one and the same machine, by shifting the carriage. For this purpose, the ways on which the carriage runs should be on a second frame, connected with the bed-frame by a swivel, just under the chisel or cutter; and the click or pall h , can, in that case, be made in two parts, to slide on each other; or there may be two clicks or palls,—one to work the ratchet-wheel for the feed-motion, when the carriage is in the position represented

in the drawings for cutting the first range of teeth, and the second to act on the ratchet-wheel when the position of the carriage is shifted to cut the second range of teeth.

Instead of reversing the line of motion of the carriage relatively to the line of the cutting-edge, for the two ranges of teeth, so that the force of the blow may be fair and equal from edge to edge of the file, the same end may be accomplished, on essentially the same principle, by retaining the same line of motion for the carriage, and reversing the cutter or chisel : that is, turning it so that, during the cutting of one range of teeth, its cutting-edge shall be diagonal to the line of motion of the carriage, and, during the cutting of the second range, the diagonal direction shall be reversed. In this case, to adapt the face of the file to the cutting-edge, the bed must be inclined transversely, first in one direction, and then in the other : because, the line of motion of the cutter being inclined, when the cutter is reversed from the one side to the other, by reason of the obliquity of the line of motion, the edge will be inclined first in one and then in the reversed direction from the transverse plane of the face of the file. To effect this, the carriage may be made in two parts, one above the other,—the upper part being connected with the lower by means of a longitudinal axis, on which it shall rock, to give the requisite inclination in opposite directions.

The patentee claims the method above described (or any mere modification thereof) of adapting the face of the file to be cut, to the cutting-edge of the chisel or cutter, so that an equal force may be applied to the whole breadth of the file, by shifting the file relatively to the cutting-edge, substantially as described. Also, connecting the chisel with the slide, by which it is operated, by means of a joint, so as to give the cutting-edge the requisite angle, and render it self-adapting to the varying texture of the metal to be cut, and to the varying planes presented by the face of the file (as it passes under the cutter), by reason of its curved form and the obliquity of the cuts required. And, finally, regulating the tension of the spring, or the equivalent thereof, so as to determine the force of the blow, by causing the plane on the carriage to act on the said spring, or its equivalent : whereby the force of the blows can be adapted to the form of the file, as described.—
[Inrolled January, 1851.]

To ETIENNE MASSON, of Place St. Michel, at Paris, gardener, for improvements in the preparation of certain vegetable alimentary substances for the provisioning of ships and armies, and other purposes where the said substances are required to be preserved.—[Sealed 12th November, 1850.]

THIS invention relates to the preparation of those descriptions of vegetable alimentary substances which are obtained or gathered in a green succulent or moist state, such as leaves, fruits, roots, and some descriptions of unripe seeds, as distinguished from those which are obtained in a dry state, such as ripe wheat or other ripe grain. It is applicable to a great variety of vegetable substances, and amongst others to cabbages, cauliflowers, spinach, sorrel, and green vegetables generally, carrots, turnips, beet-root, asparagus, French beans, peas, potatoes, apples, pears, cucumbers, melons, mushrooms, truffles, and many others.

The patentee first describes his general method of proceeding, and then the modifications, suitable for particular substances.

The general method of proceeding consists in drying the substances, at a moderate temperature, and compressing them into hard solid masses or cakes; in which state they may be preserved for a great length of time, enclosed in suitable cases; and, when required for use, they are moistened or soaked in water, and then cooked in the ordinary manner, or used without cooking, according to their nature.

The means employed to produce the desiccation consists, generally, in the application of artificial heat, obtained by hot air, steam, or hot water, or by currents of hot air. The different apparatus at present in use, for similar purposes, in various manufactures, such as hot chambers, ovens, stoves, furnaces, or boilers, heated by coal, coke, peat, charcoal, or wood, or by gas, are suitable to be employed in carrying out this invention; and the desiccation may be accelerated, when required, by the natural ventilation produced by the ascent of the hot air—or by a more rapid ventilation produced by mechanical means—or by introducing lime, or chloride of calcium, or other absorbent substance to absorb the moisture—or even by withdrawing the air and forming a vacuum where practicable. It is sufficient to submit the various vegetable substances, which are to be preserved, to artificial heat, produced by any of the before-mentioned apparatus, at a temperature and during a time varying according to the nature of

the substance and the quantity operated upon. The time will also depend upon the nature of the apparatus and the efficiency of the ventilation, whether natural or mechanical. The temperature, generally employed, varies from 75° to 145° Fahr., and it is found that cabbage leaves are dried in from 20 to 30 hours; but the patentee does not confine himself to those particular temperatures and times; as the same will vary considerably, according to circumstances. The desiccation may be accelerated by a higher temperature; but there is more risk of injuring the flavour of the substances operated upon. The substances are supported on shelves of wicker-work, or canvas, or other open material. The vegetable substances, thus dried, are next submitted to a strong pressure, by means of an hydraulic press, so as to reduce them to the form of hard dry flat cakes, which are then enveloped in tin-foil, and packed in air-tight cases of tin or zinc. In place of an hydraulic press, a screw or other press may be employed; or heavy weights may be used; or the substances may be passed between a pair of rollers; or any other similar means may be employed to forcibly compress them.

By these means, a large quantity of vegetable substance is obtained in a very small weight and space, adapted for the provisioning of ships and armies, and similar purposes. At the same time, the hard solid nature of the cakes prevents the free access of air to the interior, even when the cakes are partially exposed to the air.

The mode of using the vegetable substances, thus prepared, consists in moistening or steeping them in tepid water for 30 or 40 minutes, and then employing them in the same manner as fresh vegetables. It is convenient to form the cakes with grooves in them, to facilitate their separation into rations. This is done by forming corresponding projections or indentations on the plates of the press or dies, or on the rolls employed in compressing them.

In preparing cabbages, the leaves are first removed from the stalks, and then submitted to the before-mentioned process, either alone, or after first watering them with vinegar, diluted with ten times its bulk of water. The stalks are dried in a similar manner; but, in place of being pressed, they are ground in a mill, and reduced to the state of flour; and then packed in close vessels. Potatoes are first cut into small pieces or slices; after which, they are placed, for eight or ten minutes, in boiling water; and then they are drained and placed in the stove or drying chamber. Peas and beans are first placed in woollen bags, without removing the shells, and

dipped, for five or six minutes, in boiling water; and they are then dried, removed from their shells, and preserved in close vessels: when mixed with other substances, they are pressed; but, when alone, they are preserved in the whole state. To preserve French beans, the smaller ones are taken whole, and the larger ones divided into strips; the beans are enclosed in a cloth, and dipped in boiling water for five or six minutes; they are taken out, allowed to drain, and spread on the shelves in the drying chamber; and, when dry, they are pressed. Scarlet-runners are treated in a similar manner.

In forming the substances into cakes, according to this invention, it is not necessary to keep each substance separate; but two or more different substances may be united in the same cake: thus a cake may consist of green and red cabbages and carrots, or of other mixtures of vegetables. In this way, various mixtures of vegetables, suitable for being cooked together (as, for instance, for making soup) may be prepared, so as to facilitate the operations of the cook.

The patentee says, he has ascertained, by experiment, that cabbages and other vegetable leaves lose, by drying, about $\frac{1}{4}$ ths of their bulk and $\frac{1}{4}$ ths of their weight; so that the fresh leaves may be considered to consist of one part of dry leaf and seven parts of water. The dried leaves again take up water, when immersed previous to use. By the action of the press, he is enabled to reduce the bulk of cabbage leaves, so that a package, one foot square and four inches thick, will contain 16 lbs. weight of dry leaves,—equivalent to 400 rations, of about $\frac{1}{4}$ rd of a pound of fresh leaves each. The combined process of drying and pressing will therefore be found advantageous for the provisioning of ships and armies, and for reducing the cost of transport.

The patentee does not claim, generally, the preserving of vegetable substances by drying them; but he claims, Firstly,—the combined process or processes of drying and forcibly compressing such substances, for the purposes of his invention, as hereinbefore described; Secondly,—the preparation of the stalks of cabbages, and of similar vegetables, by drying them and then grinding them into flour or powder, as hereinbefore described; and, Thirdly,—the preparation of peas and beans, by the combined process or processes of immersion in boiling water and subsequent desiccation, as hereinbefore described.—*[Inrolled May, 1851.]*

To GAIL BORDEN, jun., of Galveston, Texas, in the United States of America, manufacturer, for improvements in the treatment of certain animal and vegetable substances, to render them more convenient for use as articles of food, and for their better preservation.—[Sealed 5th September, 1851.]*

THIS invention consists in combining flour, farina, meal, or pulverized biscuit, with a concentrated extract of the nutritive portions of animal flesh, and drying or baking the same, so as to form a portable desiccated meat-bread or biscuit, containing a large quantity of nutriment in a small bulk, and suited for the use of shipping, armies, emigrants, travellers, hospitals, and for family use.

In carrying out this invention, the patentee takes animal flesh, of any kind suitable for eating, that is fat and in good condition; and, in order to extract all its nutritive juices, he macerates it by boiling in a quantity of water until all its nutritious or alimentary properties are obtained in the decoction. The extract or decoction is filtered through strainers of wire-cloth, and further defecated by settling; after which it is reduced, by evaporation, to about the consistency of thick treacle. The evaporation may be effected in a pan or tub, with a steam-pipe coiled at the bottom, or by the vacuum process employed in sugar refining; and, previous to and during this operation, all the fat or oily matter that rises to the surface is to be skimmed off or otherwise removed. The animal extract, which has been reduced to the above-mentioned consistency, is mixed with flour, farina, meal, or pulverized biscuit, until a dough is formed, sufficiently stiff to be rolled into a convenient form, and cut into pieces by a common biscuit machine. By mixing the flour with the extract in a hot state, the dough is rendered stiffer when cold, and more of the extract is combined with a given quantity of flour, which may, if preferred, be kiln-dried. The dough is desiccated in a drying chamber, or baked in a kiln or oven. The heat employed for this purpose may be equal to that of an ordinary oven after a batch of bread has been baked in it. The dough should be baked slowly, and with great care, until it attains the same degree of dryness as the common biscuits or cracknels. The biscuits, manufactured in this manner,

* Mr. Borden obtained a Council medal for the specimens of his meat-biscuit deposited in the Crystal Palace.

may be ground into meal for greater convenience in cooking, and may be packed, either in the state of meal or unground, in air-tight casks or cases, or in tight bags of gutta-percha, varnished cloth, or other material that will keep out air and moisture.

To make soup, the biscuit is ground or pulverized, and stirred into sufficient cold water to form a thin batter, which is allowed to stand from five to twenty minutes; and then it is added to boiling water,—care being taken to stir frequently during the process, especially before it boils. The boiling is continued from ten to thirty minutes, according to the fineness of the biscuit meal, until it is dissolved in the water; and salt, pepper, and other condiments are added, to suit the taste. One ounce of the biscuit will make a pint of soup. Cooked vegetables, of various kinds, may be used in the soup.

It is stated that this biscuit is not liable to the attacks of weevils and other insects, to which ordinary biscuits and most descriptions of food are subject. It is entirely free from oil or grease, and therefore less liable to deterioration. The excellence of the biscuit depends upon the quantity of animal nutritious matter employed in its manufacture. The extract should therefore be reduced, by the process of evaporation, to about one-eleventh of the weight of the flesh, including its proportion of bone and fat: this is the proportion when fat and well-conditioned beef is used. The patentee mixes about two parts of the extract with three parts of flour, equal to five parts; but about twenty per cent., in weight, of this is lost in the baking. The biscuit may be prepared for use in a few minutes, even in a chafing-dish, over a few coals, or a spirit lamp. This invention presents another advantage,—the meat-biscuit can be made in the Colonies and other countries where meat is abundant and cheap; and, by reason of its concentration and portability, can be exported, at comparatively small cost, to countries where meat is dear and less abundant.

The patentee claims the process, above described, of treating animal and farinaceous substances, by combining the nutritive portions of flesh, in a concentrated state, with flour, farina, or meal, and drying or baking them in the form of biscuits, to render them more convenient for use, and for their better preservation.—[*Inrolled March, 1852.*]

To **BARON CHARLES WETTERSTEDT**, *of Grosvenor-street, Commercial-road, in the county of Middlesex, for improvements in preserving animal and vegetable substances.*
—[Sealed 4th September, 1851.]

THIS invention relates both to the preservation of animal and vegetable substances for use as food, and to the preservation of sail-cloth and similar fabrics.

The process, which constitutes the first part of the invention, consists in mixing the animal and vegetable substances with flour of corn, or of potatoes, or of other edible matters, drying the same, and enclosing such dried substances in vessels, so as to exclude the atmosphere. The beef or mutton to be preserved is freed from fat and bones, cut or chopped into small pieces, and mixed with flour; and the mixture is spread, in a thin layer, on shelves or trays, composed of wire-cloth, or other reticular material, so that air may pass freely through to act on all parts of the meat. The shelves or trays are placed in a chamber, into and through which dry heated air is caused to pass;—the temperature of the air at the commencement of the operation being about 70° Fahr., which is gradually raised to 120°. By this means may meat be freed from moisture, and thereby preserved, if packed in vessels so as to exclude the atmosphere; and, in like manner, may cabbage, spinach, and other vegetables, be preserved, by cutting them into small pieces, mixing with flour, drying them, and subsequently packing in air-tight vessels. During the process of drying, the matters are to be turned, from time to time, and opened out or separated, so that there may not be any large masses remaining when the drying is finished.

For packing the animal and vegetable substances, it is preferred to use earthenware bottles or jars, glazed inside and out with any suitable glaze which does not contain lead. If cork stoppers be employed for closing such bottles or jars, they are first dipped in melted bees'-wax, and, after being introduced into the mouth of the bottles or jars, they are coated on the outside with a mixture of pitch and powdered coke. When the dried substances are packed in wooden casks, the outside of such casks is coated with the mixture of pitch and powdered coke. The patentee says, he has found that powdered coke may be used with advantage inside the packages or vessels in which dried meats or vegetables are enclosed: therefore, when a bottle or jar is used, and has been nearly filled with the substance to be preserved, he covers the latter with paper or fabric, and fills the remainder of the

space with dry powdered coke; and, when other forms of vessels are used, he surrounds the meat or vegetables with powdered coke,—taking care to use means to prevent the coke from getting to the meat or vegetables.

The second part of the invention consists in preserving sail-cloth, and similar fabrics, by the application thereto of a combination of materials, as follows:—Lime of the best quality is slaked, immediately after burning, to such a degree that it will fall into powder, which is passed through a very fine sieve; then it is mixed with pulverized and sifted resin, in the proportion of ten parts of lime to one part of resin; and, to the combined materials, hot water is added, in the proportion of three gallons of hot water to each gallon of the mixture. The sail-cloth or canvas having been spread out upon a clean surface, the fluid mixture is run through a fine sieve on to it, and linseed oil, mixed with about ten per cent. of sperm, is sprinkled over the fabric; and, at the same time, the matters are spread and rubbed well into the sail-cloth with a brush. The sail-cloth, thus treated, soon becomes dry. One thousand feet of sail-cloth require about sixteen pounds of the mixture and two gallons of oil.—[*Inrolled March, 1852.*]

To PIERRE ARMAND LE COMTE DE FONTAINEMOREAU, of South-street, Finsbury, for certain improvements in preserving animal substances from decay, by means of a composition applicable to the cure of certain diseases,—being a communication.—[Sealed 4th September, 1851.]

THIS invention consists in the employment of metallic salts, but, preferably, of salts of zinc, in a state of aqueous solution, at certain degrees of strength, for preserving corpses or anatomical parts, and animal substances in general, from decay; and also in the application of such metallic solution, combined with certain emollient substances, to the cure of external diseases.

The patentee states, that the salts of zinc, as they are found in commerce, may be used in carrying out this invention; but he prefers to employ the metal itself, on account of its greater purity. A portion of zinc (previously granulated) is dissolved in water mixed with sulphuric acid, so as to form a solution of the density of from 30° to 40° Baumé; this solution is filtered and left at rest for several days, during which a deposit takes place; and then the liquid part is carefully

decanted therefrom, and used for injections, by introducing it through one of the arteries of the corpse. If the subject is intended to be exposed to the open air or in a naked condition, an addition is made to the solution, during the operation of injection, of one-third of its weight of oil of turpentine. Any desired odour is imparted to the solution by means of an essence, and a red color is given to it. To preserve anatomical parts by immersion, the solution is used in a pure state, and concentrated only to 20° or 25°: it is prepared in a similar manner to the first solution.

When the invention is applied to the cure of gangrenous wounds, and similar external diseases, the liquid is taken in the highest concentrated condition, and reduced by a decoction of linseed, marsh-mallow, or other emollient plants, to from 4° to 10°. Lint saturated with the liquid is applied to the wound, and is changed from time to time until a cure is effected. For disinfecting places, rendered offensive by the presence of organic or animal substances in a state of putrefaction, the solution is reduced by the addition of water to 10°. When it is desired to employ the solution for washing the hands and other parts of the body, it is reduced to 2° or 3°.

The patentee claims, First,—the application of metallic salts, but principally of sulphate of zinc, at the degrees above laid down, or thereabouts, for the preservation of corpses or anatomic parts, and animal substances in general, from decay, as before mentioned. Secondly,—the application of the said solution, combined with emollient substances, for the cure of wounds or other similar external diseases of the human body, as before described.—[*Inrolled March, 1852.*]

To CHARLES BARLOW, of Chancery-lane, London, Esq., for
improvements in saws,—being a communication.—[Sealed
81st July, 1851.]

THE subject of this patent is an improved mode of forming, arranging, and combining the teeth of saws of any description, to be used for sawing timber or other materials. The inventor proposes to combine two kinds of teeth in the same saw, viz., fleam-teeth, or teeth having sharp points, and chisel or planing teeth. The fleam-teeth, which have their points set slightly out from the saw-plate in each direction laterally, and stand in advance of the edges of the chisel-teeth, are for

the purpose of scribing or making two incisions, between which the chisel-teeth plane out a shaving;—the difference between the action of saws made on this principle and those of the ordinary construction being, that the common saw, in cutting, makes what is termed sawdust; while the improved saw makes shavings,—clearing itself at every cut, and therefore working with a very small amount of friction.

In Plate VIII., fig. 1, is a side elevation of part of a saw-blade, made according to this invention; fig. 2, is a vertical section; and fig. 3, is a plan view thereof. *A*, *B*, are the fleam-teeth; and *c*, *c*, are the chisel or planing teeth. The fleam-teeth may be made to stand up from the plate in any suitable shape; they are sharpened to points by bevilling off the opposite side of the plate to that on which they are intended to cut (the teeth *A*, being bevilled on one side, and *B*, on the opposite side); and the points are set slightly outwards, to make the saw-plate work clear in the cut. The chisel or planing teeth are or may be of the form of any ordinary saw-teeth, having no set; and their chisel-points may be slightly hooked, so as to present the cutting-edge at a more acute angle to the material on which the saw is acting.

The patentee says, he has represented what he considers to be the best mode of arranging the teeth in relation to each other for reciprocating mill-saws,—i. e., with two fleam-teeth and two chisel-teeth alternately, except at the ends of the saw, where he makes more fleam-teeth. In each pair of fleam-teeth, one is set in each direction sidewise; and, in each pair of chisel-teeth, one is turned in each direction lengthwise: this arrangement of the chisel-teeth enables the saw to cut both ways. Although the patentee considers that which has been just described to be the best order of succession for the teeth, he does not confine himself thereto; as they may be arranged with one fleam-tooth and one chisel-tooth alternately; or in a variety of other ways, still producing the same effect. The improvement is applicable to saws having their edges straight, or of any other form; and also to saws which cut only one way,—the chisel-teeth in the latter case being all turned in one direction.

The claim made by the patentee is for the combination, in the same saw, of fleam-teeth *A*, and *B*, and chisel-teeth *c*, substantially as above described.—[*Enrolled January, 1852.*]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in the construction of ships or vessels, and in steam-boilers or generators,—being a communication.—[Sealed 22nd August, 1850.]

THIS invention relates, first, to a peculiar mode of constructing ships or vessels intended to be propelled by stern propellers, but which is also applicable to vessels intended to be otherwise propelled; and, secondly, to an improved construction of steam-boiler or generator.

The principal object of the first part of the invention is to construct vessels, intended to be propelled by stern propellers, in such a manner as to admit of employing a propeller of greater diameter, in proportion to the depth of midship section, than is usually employed in any of the ordinary constructions of vessels: whereby the proportionate amount of resistance is reduced, and, at the same time, greater strength is given to the vessel at and about the stern,—this being an object so much to be desired in vessels intended to be propelled by stern propellers.

In order to effect this object, the vessel is made with the line of the keel inclined to the bilge-line,—the distance between these two lines being gradually greater towards the stern. This is shewn in Plate VII., wherein fig. 1, is a side elevation of a vessel, and fig. 2, is an end elevation thereof, representing the lines of the bow and stern from the midship section. The bilge-line, which is parallel, or nearly so, with the water-line *b*, is shewn at *a*; and the bilges extend downwards from the bilge-line *a*, to another line *c*, below. The keel *d*, joins the stem-post *e*, near the bilge-line, and runs down to the stern-post *f*, in a line diagonal to the bilge-line, so as to be much lower at the stern than at the bow. The floor-timbers *g*, unite the keelson and bilges, and form bent planes, as shewn at fig. 2, by reason of the position of the keel-line in relation to the bilge-line. The propeller *h*, is represented as placed in an open space, cut out of the dead wood at the stern, in the usual manner. The timbers for this construction of vessel can be united and bound together in the usual or any appropriate manner, as this forms no part of the present invention. It will be seen, that the lines of the floor, towards the bow, are flat, or nearly so, and gradually incline and curve as they approach the stern, until the lines, formed by them, are lost in the dead wood *i*, at the stern.

By this mode of construction, a much greater depth is obtained at the stern than at the bow and midship sections, so as to receive a propeller of greater diameter than could be employed in vessels of the usual construction; whilst, at the same time, the bilge-line is parallel with the water-line; so that the displacement of water is but slightly increased, as the body of the vessel passes through the water. The displacement of water by the keel, will, it is true, increase towards the stern; but, as this bears but a very small proportion to the whole displacement, it presents no very serious objection; and the lines towards the stern can be made more gradual than by the ordinary mode of construction, so as to reduce the resistance, back of the midships, in a greater ratio than the increase due to the greater depth. Another advantage, resulting from this mode of construction, is, that the stern is narrower relatively to the entire diameter of the propeller; so that the water will close in and approach the propeller more freely than on any other plan. The stern being narrower, in proportion to the depth, the timbers will more nearly approach a vertical line, and thus give more strength to resist the strain due to the location of the propeller and the machinery connected therewith. Finally, it will be seen, that the bow is in this way rendered proportionately lighter, so that it will more easily rise with the waves; and the stern, by reason of its greater depth and weight, will be prevented from rising out of the water, where it should always remain, in order to give the propulsive action.

Under this head of the invention, the patentee does not limit himself to the precise lines and proportions above specified, as these may be greatly varied; but he claims, as new, making the line of the keel inclined to the line of the bilge, and of gradually greater depth towards the stern, as above described, and for the purpose specified.

The second part of the invention consists in arranging the direct flues of steam-boilers or generators in one cylinder, and the return flues in another cylinder; which cylinders are placed side by side, or one on top of the other, and made to communicate with each other, for the free passage of water; and the shells or casings of the two cylinders are also so connected and bound together that each cylinder shall be exposed to no more pressure than would be due to a boiler of the capacity of only one of the cylinders.

Fig. 3, is a longitudinal vertical section of an improved boiler, and fig. 4, is a transverse vertical section of the same, taken in the line 1, 2, of fig. 3. *a*, and *b*, represent two cylindrical boilers, of equal diameter and length, placed one

above the other. The two cylinders are not completed; and, instead of completing the circles where the two come together, the top of the lower one *a*, and the bottom of the upper one *b*, are left open, as at *c*, for the free communication of water. The cylinders are joined by bending and uniting the plates constituting the outer casing thereof, as represented at *d*, *d'*; and the plates, so bent, are connected by means of stay-bolts *e*, *e'*, which, by binding these parts together, give to each cylinder a strength equal, or nearly equal, to two complete cylinders. The fire-box *f*, and the direct flues *g*, are arranged in the lower cylinder *a*. The direct flues open into a smoke-box *h*, at the end which extends up into the upper cylinder *b*; so that the products of combustion from the fire-chamber, after proceeding through the direct flues, may pass into and return through the flues *i*, which are arranged in the upper cylinder *b*. From these flues *i*, *i*, the products of combustion are discharged into another smoke-box *j*, which leads to the chimney. Any other mode of binding together the outer casing of the two cylinders may be substituted for that above described; and the direct and return flues, as well as the mode of connecting them, for the passage of the products of combustion from one to the other, may be varied at the discretion of the constructor.

From the foregoing, it will be understood, that each cylinder will be exposed only to the pressure due to a boiler of the capacity of one of the cylinders; whilst the entire boiler will be of double that capacity for water and heating surface. The boiler will be narrower than if constructed on the usual plan; and therefore, for marine purposes, will be less liable to accidents arising from the overheating of the fire surface, by reason of the careening of the vessel.

The patentee claims, as the second part of the invention, arranging the direct flues in one cylindrical boiler, and the return flues in another cylindrical boiler, when such cylindrical boilers are connected together, as above described.—
[Inrolled February, 1851.]

To ARTHUR ALBRIGHT, of Birmingham, in the county of Warwick, manufacturing chemist, for improvements in the manufacture of phosphorus, and in the apparatus to be used therein,—being a communication.*—[Sealed 17th July, 1851.]

THE object of this invention (which was communicated to the

* An Exhibition Prize Medal was awarded to Messrs. Sturge, of Birmingham, for exhibiting samples of amorphous phosphorus prepared by the process for which this patent is granted.

patentee by Professor A. Schrötter, of Vienna) is to produce an improved manufacture of phosphorus, which is amorphous or non-crystalline, and differing, both in its nature and properties, from the common phosphorous of commerce. The latter is well known to be crystalline in formation, of a pale yellow color (approaching, when pure, to a white), nearly transparent, luminous in the dark, and burning in the open air at a temperature of about 148° Fahr. Amorphous phosphorus, on the contrary, is opaque, of a varying red color, not luminous in the dark, and does not take fire when exposed to an ordinary atmosphere, nor even by friction or percussion, unless the temperature produced thereby exceeds 464° Fahr. (the ordinary temperature at which it is inflammable being about 482°); but, when combined with chlorate of potass, or other suitable materials, it inflames with great energy, and may therefore be used for making lucifer matches and other instantaneous igniters,—it being, moreover, free from the pernicious qualities which render the application of the common phosphorous to these purposes so dangerous to health. The amorphous phosphorus may be transported from place to place with perfect safety; whereas, the carriage of the common phosphorus is attended with considerable trouble and risk. By this change of condition, phosphorus is deprived of its poisonous quality, and of much of the peculiar and unpleasant smell which arises from the ordinary phosphorus of commerce; and it is not so liable in warm temperatures to be converted into phosphoric acid.

Fig. 1, in Plate VIII., represents a vertical section and fig. 2, a plan view of the apparatus used for making the amorphous phosphorus. *a*, is a cast-iron vessel, set in brick-work, with a fire-place beneath; and *b*, is a similar cast-iron vessel, which is suspended within the former by passing screw-pins through suitable lugs or ears, formed at the upper part of each vessel;—the space between the two vessels being occupied by a metallic bath, composed of equal parts of tin and lead. The vessel *b*, is furnished with a cast-iron cover *c*, which is formed with a bead around its lower edge, to fit into a corresponding groove in the upper edge of the vessel *b*, and is fastened to the flange of the vessel *a*, by screw-bolts *d*: this cover is used chiefly to prevent accidents, and is not absolutely necessary. *e*, is a moveable iron vessel, placed in a sand-bath *f*, and containing a vessel *g*, of glass or porcelain, to receive the phosphorus. Into the cover *h*, of the vessel *e*, is screwed one end of a curved pipe *i*, of iron or copper, which passes freely through an orifice in the cover *c*, and dips, at

the other end, into a vessel *j*, containing mercury or water (if the former, it should be covered with water): this pipe will act as a safety-valve; as the mercury or water will prevent the return of the atmospheric air into the vessel *e*. The pipe is provided with a stop-cock *k*, to prevent the ingress into the vessel *e*, of the contents of the vessel *j*, or of the atmospheric air; and this cock should be closed at the termination of the operation, before the apparatus is allowed to cool down, or the vessel *j*, is removed. During the operation, a spirit-lamp *l*, may be suspended beneath the pipe *i*, to keep the same hot, and prevent it becoming clogged up by the condensation of distilled phosphorus. The cover *h*, is held down in its place on the top of the vessel *e*, by a screw *m*, which passes through a screwed opening in the centre of a three-armed holder, and enters a recess in the cover; and beneath the end of the screw is placed a small concave disc or spring of steel, which will give a slight play to the cover *h*, in case of a violent action arising within the vessel *e*, or the pipe *i*, being stopped up.

To produce amorphous phosphorus by means of the above-described apparatus, the inventor takes phosphorus of commerce, previously melted and cooled under water, and dried as much as possible, and treats it as follows:—The phosphorus having been deposited in the vessel *f*, the covers *c*, and *h*, are fixed in their places. A fire is then made under the vessel *a*, and the temperature raised to a sufficient degree to drive off the air, and likewise the gases generated in the inner vessel, which will escape from the end of the pipe *i*, and rise through the mercury or water into the air: the action of the water in the vessel *j*, when mercury is employed, is useful, in order that any phosphorus which may distil over, and pass down the pipe *i*, may be covered thereby. The temperature is to be gradually increased until bubbles escape at the end of the pipe *i*, which take fire as they enter the air; and when these bubbles have escaped freely for some time, the heat may be raised to 500° Fahr.,—the temperature being ascertained by means of a thermometer, placed in the metallic bath before mentioned. The temperature must be maintained for a certain time (the length of which depends so much on accompanying circumstances, that it can only be determined by experience) at a point within a few degrees of the before-mentioned elevation—perhaps rather higher than lower. As soon as the phosphorus is converted into an amorphous state, the vessel is allowed to cool down; and then the phosphorus is taken out: to effect which, it may be necessary to break

the glass or porcelain vessel. If it be found desirable to increase the pressure on the vessels *e*, and *g*, the vessel *j*, should be deeper, so as to contain more mercury: by which means a pressure of an atmosphere, or even more, may be obtained. In this case, it will be necessary to remove the disc or spring so soon as the steam and fiery bubbles, which arise in the first part of the process, have ceased to appear at the end of the pipe *i*.

After the phosphorus is removed from the vessel *g*, it is levigated under water, from which it may be drained by being placed in a bag or on a filter. If the operation has been successfully conducted, the amorphous phosphorus produced contains only very slight traces of common phosphorus. The levigated phosphorus, while moist, should, in order to purify it, be spread thinly on shallow trays of sheet-iron or lead, heated by steam, or by a bath of hot water, or chloride of calcium, or sand, or of each consecutively, in the order in which they are named; but, whichever be employed, the temperature must be raised gradually, and the phosphorus frequently stirred, until the disappearance, in the dark, of all luminous vapour, indicates that the whole of the adhering crystalline phosphorus has become oxidized. There should be water at hand to extinguish any fire that might arise before the whole mass was perfectly oxidized. When the process of purification is thus far completed, the phosphorus must be washed until the water, in which it is so washed, affords no trace of acid when tested. In case the amorphous phosphorus contains too large a proportion of unconverted phosphorus, then bisulphuret of carbon, or other solvents, may be employed to wash out the ordinary phosphorus.

In conclusion, the patentee says, it will be seen that, for the conversion of phosphorus, he employs but one agent, namely, heat; but he reserves to himself the right to use other agents, in combination with heat, to facilitate or accelerate the production of amorphous phosphorus. He does not confine himself to the precise details of the apparatus above described; but he claims, as a new and useful invention, the manufacture of an improved or amorphous phosphorus, and the apparatus described, to be used in such manufacture.—
[Inrolled January, 1852.]

To ISAAC HAZLEHURST, of Marton, in the parish of Dalton, in the county of Lancaster, steel-refiner, for certain improvements in the manufacture of iron.—[Sealed 3rd June, 1851.]

THE subject of this invention is an improved method of operating upon pig-iron in the puddling-furnace, whereby the metallic mass may be brought into a spongy state, so that it may be easily broken up or pulverized, previous to being operated upon a second time in the puddling-furnace. It is stated, that the iron produced by means of this process will, when brought into a marketable state, be found more applicable for the manufacture of spades, shovels, sickles, hooks, scythes, rivets, boiler-plate, sheet-iron, tin and black plates, wire, and other purposes for which iron of a superior quality is required.

In carrying out the invention, the patentee introduces into the ordinary puddling-furnace the usual charge of pig-iron, or pig and refined iron, or pig-iron with a mixture of iron ore and carbonaceous matter, such as ground coal, coke, charcoal, or sawdust. The iron is melted and brought to as thin or liquid a state as possible, for the purpose of well clearing the iron; and the process of puddling is carried on in the usual manner. The damper is then lowered until the iron begins to thicken; after which, it is boiled, and kept very hot until it becomes very thin or liquid. The draft of the furnace should be then checked until the metal is brought into a malleable state and is ready to "ball." When this is the case, the iron should be drawn out in pieces of any size, without being balled, and placed in a closed barrow or other receptacle, in which it can be shut in, and the external air kept from it until it is cool. When cold, the lumps of iron will be found to be in an open, spongy, or honeycomb state, and should then be ground or crushed by rollers or stampers; and all pieces of iron of a bad quality, or of raw or imperfectly worked iron, dirt, or other impurities, which would injure the quality of the iron, must be carefully picked out from the good iron. The manufacturer must take as much of the ground or crushed iron as will be sufficient for the bloom or bar intended to be made, and introduce it into the same, or some other furnace, suitable for the purpose, and having a cinder or sand-bottom. The iron must be balled at a low heat in this furnace in the ordinary manner, and afterwards finished, either under the hammer, or in the squeezers or

rolls, as usual; as the iron, made according to this improved plan, does not require any cutting and piling.

The iron, thus produced, will be found peculiarly applicable to the above-mentioned purposes; but, if it be required to be polished when made up, the ground or crushed iron should be scoured before being introduced into the furnace to undergo the balling operation. The patentee also uses the ground iron for sinking in the charcoal fires, and for making iron for conversion into steel, instead of charcoal pig-iron, or best scrap-iron, as is now the case. By this means, a considerable economy in the cost of the iron is effected; and, at the same time, iron of as good quality is obtained.

The patentee claims, as his invention, stopping the puddling process at a certain point, as above set forth, so as to obtain the iron in a spongy or honeycomb state, and then grinding or crushing the iron in that state, so as to admit of the picking or sorting operation taking place, in order that, previous to any subsequent working, all crude metal, dirt, or other impurities, which would injure the quality of the good iron, may be removed therefrom, as above described.—[*Inrolled December, 1851.*]

To TIMOTHY KENRICK, of the parish of Edgbaston, in the county of Warwick, iron-founder, for improvements in the manufacture of wrought-iron tubes.—[Sealed 4th September, 1851.]

THE subject of this invention is the enamelling and glazing of the interior of wrought-iron tubes.

For this purpose, two coatings are applied,—the first being a composition, to form the body of the enamel, and the second forming the glaze. When the inner surface of the tube has been cleaned, the first composition (presently described) is poured through the tube, which is, at the same time, turned round, to ensure an even coating upon every part; and the composition is allowed to set. The composition is prepared by mixing 100 lbs. of calcined flint, ground to a fine powder, with 75 lbs. of borax, ground fine, and then fusing the mixture; when it is cold, 40 lbs. of the fused matters are ground in water with 5 lbs. of potters' clay, and brought to such a consistence that, when an article is dipped therein, a coating about $\frac{1}{8}$ th of an inch thick will be left upon it, forming the first coating, or body, to support the glaze. After the first composition is set, the second composition, or glaze powder,

is poured through the tube, which is turned round, so as to cause the powder to cover every part of the first composition. The second composition, or glaze powder, is made as follows:—100 lbs. of Cornish stone, ground to a powder, 117 lbs. of borax, ground fine, 85 lbs. of soda-ash, 85 lbs. of saltpetre, 85 lbs. of sifted slaked lime, 18 lbs. of white sand, and 50 lbs. of white glass, pounded fine, are mixed together and perfectly vitrified; when cool, the mixture is ground very fine in water, and afterwards dried; and then 45 lbs. thereof and 1 lb. of soda-ash are mixed together in hot water (being well stirred), and dried in a stove: by which means, a fine glaze powder is produced. The glaze powder having, as before, been poured through the tube, the latter is put into a stove, heated to about 212° Fahr., to dry it; and, after this, the composition is fired, by placing the tube in a kiln or muffle, heated to a sufficient temperature to fuse the glaze. When the glaze is fused, the tube is withdrawn and examined; and, if the interior is not perfectly covered, a second coating of glaze powder is applied (by pouring the powder through the tube whilst it is hot), and the tube is again replaced in the kiln until the glaze is fused.

The patentee states, that the interior surfaces of cast-iron tubes have been heretofore enamelled and glazed by the application of two coatings,—one for the body, and the other for the glaze. Now, he claims, as his invention, the enamelling and glazing, in the manner before mentioned, of the interior surfaces of wrought-iron tubes only. He further declares, that the exact proportions of the materials, above given, in the recipes for the two coatings, are not essential, but may be varied. Nevertheless, he considers such proportions to be the best that can be employed.—[Inrolled March, 1852.]

To ALEXANDER PARKES, of Birmingham, in the county of Warwick, chemist, for certain improvements in the manufacture of copper, and in the separation of some other metals therefrom, and in the production of alloys of certain metals.—[Sealed 11th September, 1851.]

THE improvements in the manufacture of copper, which form the first part of this invention, consist in using iron and zinc in certain stages of the processes of smelting, whereby better copper is obtained from inferior ores than has heretofore been the case.

Firstly, with regard to iron, it may be added to the copper when in the state known as "white metal," or in any of the more advanced stages, provided sulphur be present; but the following plan is preferred to be adopted:—The ores are treated as usual until the product has reached the roaster-furnace, and, by being allowed to cool therein, has become "close regule." The iron (either in the state of wrought or cast-iron) is now added, in the proportion of 1 cwt., or thereabouts, to a charge of about $2\frac{1}{2}$ tons of the regule; the furnace doors are closed, and the heat raised; and the product is tapped as "pimple copper." In this state it is removed to the refining furnace, where it is treated in the ordinary manner; or, in some cases, it is treated with metallic zinc, as hereafter described. Sometimes, after the introduction of the iron into the roaster-furnace, the metal is run out as "light regule," and the pigs stripped in the manner practised when making best selected copper; the portions which have been stripped are then introduced into the roaster-furnace, with $\frac{1}{2}$ cwt. of iron to a charge of about $2\frac{1}{2}$ tons of metal; and the charge is allowed to remain in the furnace until it becomes pimple copper, which is then tapped and removed to the refining furnace, as before mentioned: this second operation with the iron will only be necessary when very pure copper is required. In some cases, the iron is added to the metal in the refining furnace, in the proportion of 1 cwt. to each charge of from 4 to 5 tons; then the metal is well agitated, to oxidize the iron; and, when it has arrived at "set pitch," it is poled in the usual manner, and laded out of the furnace; or metallic zinc may be added previous to poling, as hereafter described. The patentee does not employ iron in the refining furnace with copper which has been previously treated with iron in the roaster-furnace.

With regard to zinc, the invention consists in adding it to copper when in a fused state in the refining furnace. To each charge of 5 tons of copper, whether the same has been treated with iron, or smelted in the ordinary way, about 1 cwt. of metallic zinc is added (by preference, when the copper is at set pitch); and, after the charge has been permitted to remain in a melted state for a couple of hours, so that the zinc may volatilize, it is poled and laded out as usual.

The patentee states, that he does not confine himself to the exact proportions above given.

The improvements in separating some other metals from copper, which constitute the second part of this invention, relate to the treatment of argentiferous compounds of that

metal, and will be understood from the three following processes, which are dependent upon the discovery, that silver is easily volatilized when in connection with zinc and arsenic in a fused state, and are modifications of this discovery applied to the treatment of compounds containing silver. In carrying out these improvements, a reverberatory furnace is employed, having a flue and chambers connected therewith, suitably arranged for collecting the products that pass from the furnace; and, when so collected, they may be cupelled, or otherwise treated, to obtain the silver.

1.—If the argentiferous compound is in the metallic state, and contains 10 oz. of silver in the ton, the patentee adds to each ton of it, when melted in the reverberatory furnace, from 3 to 5 per cent. of metallic zinc, from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of white arsenic, and about $\frac{1}{2}$ cwt. of anthracite coal, or other carbonaceous matter; and he then closes the furnace doors, and heats the whole together for about 6 hours: by which time the silver will have passed over with the zinc and other volatile metals, and become condensed in the flue and chambers connected with the furnace.

2.—When the prevailing state of the compound is that of a sulphuret, it is fused in the furnace; and, to each ton of it, is added from 6 to 10 per cent. of calamine, or other oxidized compound of zinc, together with lime, or other flux, if required, and $\frac{1}{2}$ cwt. of anthracite coal; and, if the compound is free from arsenic, from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of white arsenic is also added: the remainder of the process is the same as the preceding one. It is preferred to add the zinc and arsenic to the sulphuret compound when in the state of "pimple metal."

3.—In case the argentiferous compound consists chiefly of oxide or carbonate of copper, then to each ton is added from 10 to 15 per cent. of blende, or other sulphur compound of zinc, from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of white arsenic, and about 1 cwt. of anthracite coal, together with a flux, if necessary; and then the operation proceeds as in the first and second processes. The patentee prefers to add the sulphur compound of zinc and the arsenic after the compound has been fused and skimmed to remove the earthy matters.

The above are the proportions for argentiferous compounds containing about 10 oz. of silver to the ton; but, if the amount of silver be greater than this, the quantity of zinc and arsenic is increased in the same relative proportion; and, when the compounds contain above 50 oz. to the ton, the zinc and arsenic should be added by degrees, instead of the whole quantity at once. The patentee states, that he has directed

white arsenic to be used in the above processes, only because it is the most convenient compound of that metal with which he is acquainted; but other compounds, or metallic arsenic itself, may be employed,—taking care to use an equivalent proportion of the metal to that in the compound above mentioned.

The last part of the invention consists in improvements in the production of alloys, by combining nickel with chromium, and subsequently adding other metals to such alloy, according to the purposes for which it is required. The patentee prefers to take oxide of chromium and oxide of nickel, in equal proportions, or two parts of oxide of chromium and one part of metallic nickel, and to fuse them together in a closed crucible, well covered with a carbonaceous flux; and, having obtained this alloy, he remelts it, and adds other metals thereto in various proportions, according to the nature of the alloy desired to be produced. The following proportions have been found to produce good results when white alloys have been required:—Alloy of nickel and chromium 10 parts, and tin 90 parts; or alloy of nickel and chromium 20 parts, and iron 80 parts; or alloy of nickel and chromium 20 parts, copper 60 parts, and zinc 20 parts.—[*Inrolled March, 1852.*]

To WILLIAM JACKSON, of the town and borough of Kingston-upon-Hull, soap-maker, for improvements in the manufacture of soap, and in the preparation of materials to be used for this purpose.—[Sealed 11th June, 1850.]

THIS invention consists, firstly, in subjecting resin, to be used in soap-making, to repeated washings in alkaline solutions; secondly, in charging such washed resin with alkali; and thirdly, in mixing such washed and alkalized resin with soap, in a fluid state, in the frames or any other vessels.

In carrying out the invention, the patentee prefers to employ a circular pan of wrought or cast-iron, or other fit material (say about five feet in diameter and about three feet deep), set in masonry or brickwork, and heated by fire under the bottom; and, within the pan, he places a pipe or pipes, perforated with small holes. This pipe, or system of pipes, should be placed round the bottom of the pan,—the open extremity of the pipe or pipes being in communication with a steam-boiler, and furnished with a tap, to regulate the ingress of steam. The pan is charged with, say, ten hundred-weight of resin, broken into small pieces or coarse powder; and,

before the fire is lighted below the pan, the latter is nearly filled with water. The action of the fire is continued until the resin and water come up to boiling heat; and when this has been effected, either the fire is raked out, or it is prevented from acting upon the bottom of the pan by means of a damper. Then, into the mixture of resin and water about twenty gallons of soap-makers' lees, or other suitable alkaline preparation or mixture, are thrown; and steam is turned on through the pipe or pipes into the pan, so as to keep it in a boiling state for twenty or thirty minutes. At the expiration of that time, the steam must be shut off, so as to allow the resin to settle to the bottom of the pan, which it generally does in a few minutes. Should it not settle so soon as desired, or the liquor be found to be charged with an excess of resinous matter, about twenty pounds of coarse common salt are to be thrown into the pan: this addition will, at once, cause the resin to subside, and settle to the bottom, and thereby throw down any such excess of resinous matter.

The water in the pan, which will be of a dark red color, and slightly alkaline, is now baled or run off from the resin, and the pan is again nearly filled with water, into which about ten gallons of lees, or other alkaline mixture, are thrown. This mixture is boiled about ten minutes, by means of the steam alone, admitted through the coiled pipe; and then the water is discharged from the pan, and the washing with water and alkaline lees again repeated until the liquor comes off nearly colorless. Four or five washings will, generally, be sufficient to produce the result required; but the number will vary, according to the resin operated upon.

The patentee has found it advisable, in some cases, to increase, and, in others, to decrease the quantity of alkaline lees employed in each washing; but the quantity must, in some measure, be left to the judgment of the operator; as some resins will require more alkaline lees than others to extract the coloring matter. When the resin has been thus prepared, a sample, taken from the pan, will, on becoming cold, be found tolerably stiff, and approaching to hardness, and resemble, in appearance, the ordinary yellow resin of commerce. This prepared resin is to be employed in the ordinary manner of making soap, by adding it to the fatty or oleaginous matter in the soap-pan, from time to time, as required.

With regard to the second part of the invention, the patentee puts a quantity of the washed resin (prepared as before described) into an iron or other pan, and, having heated it by

means of a current of steam admitted into the pan, he adds strong soap-boilers' lees, or other similar alkaline preparation, thereto, in sufficient quantity to saturate or saponify the resin. He then turns off the steam, and allows the resin to subside; and, when perfectly cold, he draws off the refuse spent lees. After this, he adds to every hundred-weight of the resin, twenty pounds of soda-ash, of 50 per cent. strength, and stirs up the mass by any convenient means, so as thoroughly to incorporate the soda-ash with the resin. In stating that he uses twenty pounds of soda-ash to one hundred-weight of resin, he does not intend to confine himself to that quantity; as it may be advantageously varied, to suit the different kinds of soap which it is intended to be mixed with.

The third part of this invention is carried into effect by adding to every ton of soap in the fluid state, as cleansed from the soap-pan, from three to five hundred-weight of the washed resin, according to the quality of the soap required, and mixing or crutching it into the frames, or any other vessel, in the same manner as if water was used.

The patentee claims, as his invention, Firstly,—washing, (for the purpose of purifying) resin in alkaline solutions of potash or soda, for the use of soap-makers. Secondly,—charging such washed resin with potash or soda-ash. Thirdly,—mixing the washed resin (prepared as before described) with finished soap in a fluid state, in the frames, or any other vessel.—[*Inrolled December, 1850.*]

To JOHN MORTIMER, of Hanover-square, in the county of Middlesex, Esq., for improvements in the magnetic needle and mariner's compass.—[Scaled 7th December, 1850.]

THE first part of this invention consists in a peculiar mode of suspending the magnetic needles of mariners' compasses. In Plate VIII., fig. 1, is a plan view of a compass-card; and fig. 2, a vertical section of the card and needle. The magnetic needle of a mariner's compass, made in the ordinary manner, extends across the under-side of the card, from edge to edge, and has its axis of motion at the centre of its length. Now, the patentee proposes that the axis shall be near one end of the needle (*a*, fig. 2,) which extends from one edge to a short distance beyond the centre of the card; and, to balance the needle, he affixes a piece *b*, of brass, or other metal which is not magnetic, to the under-side of the card. It is stated that, by this arrangement, the needle is made to come more

quickly to rest, and that the action of the needle is better. In fig. 1, the south pole of the magnetic needle is represented as most distant from the axis of motion; but this arrangement may be reversed; and the patentee recommends the use of two compasses,—one having the south pole of its needle most distant from the axis of motion, and the other having the north pole of its needle most distant therefrom.

The second part of the invention consists in constructing mariners' compasses as represented in plan view at fig. 3. The axis of the magnetic needle *a*, instead of being coincident with the axis of the compass-card *c*, is carried by a slide, which can be moved in a groove *d*, to any point or graduation on the card (or hemisphere) representing the latitude of the place of observation; and if the instrument be fitted with sights, whereby the pivot on which the needle traverses and the centre or pole of the card may be placed in a direct line with the meridian—then, by adjusting the hand or pointer *e*, to the direction that the needle takes, the variation will be at once shewn. For instance, as shewn at fig. 3, supposing the latitude to be 40° north, and the groove to be placed in a direct line with the terrestrial pole, and the axis of the needle set to 40° , the declination then appears to be $16\frac{1}{4}^{\circ}$. The hand or pointer *e*, turns upon the axis of the needle, so as to admit of being set in a line with the latter, and thus, as it were, extend the length thereof, in order to indicate, with greater exactness, the graduation of the scale to which the needle points; and there are dots *f*, upon the hand *e*, to shew when the points of the hand and of the needle are in the same line.

The last part of the invention relates to dipping-compasses, and consists in suspending the frame of the dipping-needle by a universal joint, so that it may at all times hang in a vertical position. Fig. 4, represents a dipping-compass so constructed. The loop *g*, whereby the instrument is suspended, is connected to the ball *h*, by two pivots or axes *i*, opposite to each other; and the ball is connected to the frame *j*, by two pivots or axes *k*;—the whole forming a universal joint.

The patentee claims, Firstly,—the means of suspending the needles of mariners' compasses. Secondly,—the construction of mariners' compasses described with respect to fig. 3. Thirdly,—the mode of suspending dipping-compasses above described.—[*Inrolled June, 1851.*]

To DOMINIQUE JULIAN, of Sorgues, France, for improvements in extracting the coloring properties of madder, and in rendering useful the water employed in such processes.
—[Sealed 4th September, 1851.]

THIS invention consists in certain processes for extracting the coloring properties of madder, and for obtaining a spirit from the water that has been used in the extracting operation.

Madders of all qualities may be treated according to this invention, which is carried into effect as follows:—2 cwt. of madder, reduced to powder, are thoroughly mixed or diluted with from 113 to 118 gallons of water (according to the fineness of the powder); and then the liquid is run through a filter, composed of a woollen cloth, fixed upon a frame, within a tun or vessel, which receives the water, and is furnished with a cock for discharging the same. The filter will contain 6 cwt. of madder; so that, when the above operation has been thrice performed, it will be full. The water is then drawn off, through the cock, into large wooden tuns; and the madder, which is now a wet paste, is put into linen bags or baskets, and subjected to the action of an hydraulic press, in order to extract the remaining water,—such water being added to that before drawn off. After the paste has been well pressed, it is placed in sieves heated to from 120° to 160° Fahr.; and, when it is perfectly dry, it is reduced to powder, and passed through a sieve. The patentee states, that a given quantity of this product (which he calls flowers of madder), when employed in dyeing, will have a greater effect than a like quantity, by weight, of the madder from which it has been extracted.

The water collected from the filter and hydraulic press is put into large wooden tuns, placed in a room heated to from 70° to 85° Fahr.; and it is kept in these tuns until alcoholic fermentation takes place, or for the space of five or six days. If by that time the alcoholic fermentation is not produced, the patentee puts into the tun five gallons of boiling water, in which ten or twelve pounds of barm have been dissolved. On finding that the density of the water, which was from 3° to 8° Baumé when introduced into the tuns, is reduced to from 1° to 2°, he knows that the alcoholic fermentation has been produced; and he then submits the liquid to the process of distillation, in order to obtain a spirit therefrom.—[*Inrolled March*, 1852.]

Scientific Notices.

EXPLANATION OF

Diagrams illustrating the action of the forces on the crank of a Steam-engine. By W. POLE, C.E.

[In the year 1849, the Society of Arts offered a prize "for the best collection of diagrams (with explanations) to illustrate the action of the forces on a crank or cranks turned from a horizontal direct-action steam cylinder or cylinders; the effect of various proportions of connecting-rods, and degrees of expansion of steam, being shewn."

The present paper was communicated to the Society in accordance with their invitation, and obtained the silver Isis medal. It is now first printed by the joint permission of the Society and the author.]

THE 15 diagrams contained in Plate IX., illustrate the action of the forces on one and two cranks, turned from horizontal direct-action steam-cylinders,—the effect of various proportions of connecting-rods, and degrees of expansion of steam, being shewn.

The varieties of expansion, taken in these diagrams, are three, viz. :—

Steam admitted during the whole stroke	(Nos. 4, 5, 6).
" " half the stroke	(Nos. 7, 8, 9).
" " one-fourth the stroke	(Nos. 10, 11, 12).

It has not been thought necessary to exhibit a higher degree of expansion than four times,—this limit being seldom exceeded in crank-engines.

The varieties of length of connecting-rod have also been taken at three, viz. :—

Connecting-rod indefinitely long (supposed to act always in parallel directions).	(Nos. 1, 4, 7, 10).
Connecting-rod five times the length of crank, which may represent about the ordinary length.	(Nos. 2, 5, 8, 11).
Connecting-rod three times the length of crank, or about the shortest made.	(Nos. 3, 6, 9, 12).

Diagrams Nos. 1, 2, and 3, are explanatory of the action of the forces, in the transmission of the power from the piston to the crank, for the three varieties in the length of connecting-rod respectively. AB is the piston-rod, supposed to be propelled forward by a certain pressure of steam, in the direction shewn by the arrow. At the joint B, this pressure resolves itself into two : one in the direction BG, (causing the friction on the guide); the other along the connecting-rod BC ;—the latter force being = the pressure on piston $\times$ secant of angle CBD. At the crank-pin C, the force acting along the connecting-rod, is again resolved into two ; one along the crank CD ; the other, the *tangential force*, tending to turn the

crank round in the direction CT. This tangential force is = the force acting along connecting-rod $\times$ sine of angle BCD.

The object of diagrams Nos. 4 to 12, is to exhibit the values and variations of the first and last-named forces; or, so to speak, the forces at the beginning and end of the engine; i. e., the pressure of steam on the piston, and the force turning the crank round.

Each of these diagrams contains two figures. The left-hand figure shews the pressure on the piston at all points of the stroke, on the plan of rectangular co-ordinates; the abscissa representing the space passed over by the piston, and the ordinate the corresponding pressure. Thus, when the piston has moved from 0 to x , No. 8, or $\frac{1}{10}$ of the whole stroke, the steam pressure upon it is represented by the line xy . The scale given under the left-hand figure, in Nos. 4, 5, 6, and which also applies to Nos. 7 to 12, shews the position of the crank corresponding to any given position of the piston:—thus, in No. 6, it is seen, by inspection, that when the piston has passed through $\frac{1}{10}$ of its course, the crank has passed through about 81° from the dead point; and so on.

The right-hand figure in each diagram represents the tangential or working force, acting on the crank-pin, at every point of its semi-revolution from E to F, Nos. 1, 2, and 3. The curve of this figure is also laid down by rectangular co-ordinates: the path of the crank-pin (reduced to a straight line) forms the line of the abscissæ, while the ordinates express the corresponding forces. Thus, in fig. 5, when the crank-pin has moved from 0 to θ , or 120° from the dead point, the tangential force, tending to turn it round, is represented by the line $\theta\rho$.

The additional scale, under this figure, shews the position of the piston corresponding to any given position of the crank: thus, in fig. 5, when the crank is at 140° , the piston has moved through $\frac{4}{10}$ of its stroke, and so on.

The lines representing the forces are measured by a scale, which is appended to figure 4. The pressure of the steam upon the piston, while the steam-valve is open, is made = 100 on the scale; and the ratio of any other force to this pressure is therefore easily ascertained by simple measurement.

Diagrams 4, 5, and 6, shew the values of the forces when the steam is admitted during the whole stroke.

In No. 4, the connecting-rod is supposed indefinitely long; the pressure on the piston is uniform at 100. The tangential force on the crank-pin begins at 0 when the crank is at the dead point; increases to 100 when it arrives at 90° ; and

diminishes again to 0, in the same ratio as the increase. The mean value of the force, throughout the semi-revolution, is $=68.6$, which, $\times$ the space passed through by the crank-pin, is exactly $=$ the pressure on the piston $\times$ the length of its stroke; or, in other words, the area of the figure efg $=$ the parallelogram $abcd$. This result is in accordance with the principle of "conservation of *vis viva*," by which we know, that (neglecting friction) the amount of power or work given out at the crank-pin is equal to that performed by the steam on the piston.

In No. 5, is seen the effect of the connecting-rod being made five times the length of the crank. Here the tangential force, commencing at 0, arrives at a maximum value of about 102 when the crank has passed through about 80° .

In No. 6, where the connecting-rod is three times the length of the crank, the tangential force arrives at a maximum value of about 106 when the crank has passed through about 75° .

It will be perceived, however, that these variations make no difference in the mean force throughout the whole figure,—the effect of the connecting-rod being merely to vary, in a slight degree, the distribution of the force over the path of the crank-pin, without affecting the total amount of power conveyed by it to the machinery. The comparative merits of long and short connecting-rods in other points of view, involve considerations which it would be out of place to introduce here.

The return stroke, or the other semi-revolution of the crank, does not exactly correspond with the figures shewn in diagrams 5, and 6, owing to the reversed position of the connecting-rod. The nature of the variation will be seen in fig. 6*, where the tangential force is shewn for an entire revolution of the crank. It will be observed here, that the force at 10° corresponds with that at 350° , at 60° with 300° , and so on.

Nos. 7, 8, 9, shew the effect of cutting off the steam at half the stroke. Here the mean pressure on the piston is $=84.6$, and the mean tangential force on the crank-pin is $=54$,—the equality between the areas of the right and left-hand figures being still preserved. The power of the engine is diminished in the proportion of 1000 : 846, although the economy is much increased, as is well known.

Nos. 10, 11, 12, shew the effect of cutting off the steam at one-fourth of the stroke. Here the mean pressure on the piston is $=59.6$, the mean tangential force is $=38$; and the power of the engine is reduced from 100 to 59.6.

Nos. 9*, and 12*, shew the values of the tangential force through an entire revolution of the crank, in the cases above alluded to under corresponding numbers.

Combined action of two engines, with cranks fixed at right angles to each other.

The effect of two engines, so coupled, is shewn in six cases out of the nine previously described; namely, with three variations in the degree of expansion, and two in the length of connecting-rod. The curve of tangential forces is laid down for two cranks in diagrams Nos. 4, 7, 10, 6*, 9*, and 12* ;—in the three former, for half a revolution (the other half being precisely similar), and in the three latter, for a whole revolution of the crank.

It is presumed that these figures will be understood without any further description. As an example,—at θ , (No. 9*), one crank is supposed to have travelled 130° from the dead point E (No. 3),—the tangential force on it being expressed by the line $\theta\rho^1$: the second crank will then have travelled 220° from the same point; and the combined tangential force will be represented by the line $\theta\rho^2$. The undulations of the upper line will therefore represent the inequalities of the working power in the crank-shaft throughout its whole revolution.

Method of construction of the diagrams.

In laying down the forces in these diagrams, the following points have been assumed:—

(a). That, as long as the steam-valve remains open, the pressure of the steam in the cylinder is uniform. This is not always the case in practice; but must generally be assumed in calculation.

(b). That, after the steam-valve is closed, the steam expands according to Marriotte's law,—the pressure varying inversely as the volume. This is the usual assumption: the causes of variation from this law are treated of in works on the steam-engine; but cannot be comprehended in an investigation of the present nature.

(c). That no power is lost by friction, in the transmission of the force through the machine.

(d). The influence of the clearance space on the volume of the steam, in expanding, has been neglected. This is but of small moment; and its introduction would have interfered materially with the simplicity and clearness of the diagrams.

(e). The moving parts are supposed to have no weight or mass; the forces being considered in a statical point of view only.

The curves have been formed by finding the length of ordinates at convenient distances apart, and tracing a curved line through the points thus obtained.

The left-hand figures in diagrams Nos. 4, to 12, representing the pressures on the piston, are so simple, that the method of their construction need not be further alluded to than by stating, that the expansion-curve, in figs. 7, to 12, is a hyperbola; the property of which is, that (in fig. 8,)

$$\text{As } oa : ob :: lp : xy$$

which follows from Marriotte's law.

The lengths of the ordinates in the right-hand figures (the tangential forces) have been found in the following manner:—

Let Nos. 2, and 3, represent a given position of the engine. Draw the tangent CT. Produce the line of connecting-rod BC; draw CH parallel to AD, and set off CH = the pressure on the piston at that position of the engine. Draw HJ perpendicular to CH; and from the point J, where it cuts the line of connecting-rod, draw JT, parallel to DC,—cutting the tangent CT in T; then CJ is = the force along the connecting-rod, and CT is = the tangential force on the crank-pin, which is the ordinate required.

The curves in the diagrams may be expressed by algebraical equations, as follows:—

For the pressure of steam on the piston, in expanding, as shewn in the left-hand figures Nos. 7, to 12. Let the pressure on the piston, while the steam-valve is open, = P ; and let l = length of stroke passed over before the steam-valve is closed. Then if x = any length passed over greater than l , and y = the corresponding pressure, we have, by Marriotte's law—

$$y = P \frac{l}{x}.$$

For the tangential force on crank-pin, as shewn on the right-hand figures Nos. 4, to 12. Referring again to diagrams Nos. 2 and 3, let

- r = CD, the radius of crank,
- c = BC, length of connecting-rod,
- θ = angle CDE,
- ϕ = angle CBE,
- z = force acting along connecting-rod,
- f = tangential force required (= CT).

Then, by statical rules, we have, while the steam-valve is open—

$$z = P \sec \phi,$$

$$\text{and } f = z \sin (\angle BCD);$$

whence, after making all necessary trigonometrical reductions, we arrive at the equation required :—

$$f = P \sin \theta \left\{ 1 + \frac{\cos \theta}{\sqrt{\frac{c^2}{r^2} - \sin^2 \theta}} \right\}$$

After the steam is cut off, and the pressure in the cylinder becomes variable, we have

$$\text{Pressure on piston} = P \frac{l}{c + r \text{Vers } \theta - \sqrt{c^2 - r^2 \sin^2 \theta}};$$

which must be substituted for P in the preceding equation.

REAPING AND MOWING MACHINES IN THE GREAT EXHIBITION.

THE inconvenience to which agriculturists are subjected, in gathering in their cereal crops, from the want of an immediate and adequate supply of reapers when the weather is most favorable for their operation, has induced many ingenious men, during the present century, to turn their attention to the subject, with the view of substituting self-acting machinery for the sickle and the scythe. The most successful among the early attempts at reaping by mechanical means, seem to have been those of Mr. Smith, of Deanston (a man renowned in the annals of agriculture), and the Rev. Patrick Bell. A description of the machines invented by these gentlemen is published in *London's Encyclopædia of Agriculture*; from which it appears, that the first trial of Mr. Smith's machine took place during the harvest of 1811, and that Mr. Bell's was publicly tested in 1828; but, although fair results were in each case obtained, they were, from some unexplained cause, abandoned by their inventors, and were, consequently, lost sight of by the public;—thus affording another instance, if such were wanted, of the utter inutility to the general public of the most valuable suggestions, unless thrust upon their notice by some party who is pecuniarily interested in introducing them in a practical form. That these machines contained the elements necessary for an efficient reaper there can be no doubt; and it is, perhaps, owing to this fact, that nothing was done by independent parties to bring them into use. But, however this may be, it is evident that neither the requirements of the farmer, nor the prospect of reward to agricultural implement makers, were sufficient to awaken pub-

lic attention to the national importance of reaping by mechanical means. The credit of effecting this step in advance is undoubtedly due to our transatlantic brethren, whatever may be the ground for disputing the novelty of the two rival American reapers, which, from the practical illustrations of their efficiency, have of late excited so much interest in the agricultural world; and there is little doubt that, at the coming harvest, manual labor will be, in great part, superseded by this class of machinery.

The first of the reaping machines which we shall notice, as contributed to the Great Exhibition, is Mr. McCormick's: this was contained in the American department, and to it a Council medal was awarded. It consists of a triangular wooden frame, mounted on a small running wheel with a broad tire, and having a pole and whippetrees secured to the fore part thereof. The back rail of the frame projects horizontally on the left or near side to the extent of about six feet, and forms the front part of a platform, of like breadth, and nearly five feet deep, which is supported on the further side by a wheel of less diameter than the first-named. From the front edge of the platform numerous fingers or prongs, shaped like the head of a spear, project in a horizontal position, at equal distances apart. Close under these prongs is a thin steel cutting-blade, which extends across the front of the platform, and receives a reciprocating motion from right to left (as the machine is drawn onward), by its connection with a crank on a small upright shaft, driven by bevil gearing from the axle of the first-named running wheel. The front edge of the blade is either straight or of a zig-zag form: in either case it is notched or toothed, like a sickle, and divided into sections corresponding to the number of fingers,—each section having one half of the teeth inclined in one direction, and the other half in the opposite direction. Above the front edge of the platform there is a reel or gatherer, consisting of four wooden vanes or blades (about six feet long and nine or ten inches wide), carried by arms from a horizontal shaft, which is driven by an endless band, that transmits rotary motion from the rim of a wheel on the axle of the larger running wheel to a pulley on the reel-shaft. The use of this reel is to keep the corn, while being cut, in contact with the cutting-blade. To the side of the triangular frame is affixed a wheel-board or guide, which turns the standing corn inwards on the off-side of the platform; and, on the near side, there is another guide or separator, which turns inwards the corn that is before the machine, and puts aside the corn that is not to be cut until

the next time that the machine passes around the field. The triangular frame supports a seat for the man who drives the horses that draw the machine, and one for the man who gathers the grain from the platform as it is cut. The operation of reaping with this machine is as follows:—The machine is brought to the edge of the field, with the platform in front and the horses at the side of the crop to be cut down;—part of the corn being first cut away by hand, at the edge of the field, to form a path for the horses. As it is drawn onward, the reel rotates slowly, and the knife or cutting-blade moves rapidly to and fro; the fingers receive the standing corn in the spaces between them, and hold the stalks while the knife severs them (which operation is assisted by the blades of the reel inclining the corn towards the platform); and, as the cut corn falls on to the platform, it is raked, in quantities sufficient to form a sheaf, on to the ground at the off-side of the machine. A clear space is thereby left for the return of the reaper, in case the binding of the sheaves may not have kept pace with its progress.

The American department also contained another reaping machine, the invention of Mr. Hussey; and, from the fact of its missing the Council medal, it was generally supposed to be inferior to Mr. McCormick's: the latter gentleman, however, not content with having virtually beaten all the world, in an evil hour suggested the means of beating himself, by challenging all competitors to meet him in the field, and prove the quality of their implements. This challenge was accepted by his fellow countryman, Mr. Hussey; and the result of the trial, which came off before a jury of the Cleveland Agricultural Society, is thus reported by the *Gateshead Observer*:—"The laurels so recently placed upon the brow of Mr. McCormick, have been plucked off—not wholly, but in great part—by his fellow countryman, Mr. Hussey. Both machines proved their ability to do good work; but Mr. Hussey's attested its superiority; and the English farmer has now seen, thanks to Prince Albert and the Exhibition of the Works of Industry, that his corn and grasses, hitherto slowly and laboriously reaped with the sickle and the scythe, may be *planed* off the land, in five feet breadths, as rapidly as a horse can trot."

In Mr. Hussey's machine, the platform is fixed to the side of, and parallel with, the frame to which the pole and whippletrees are connected; it is furnished with suitable guides at each side, to direct the standing corn; and it is supported on the near side by a small wheel, and on the off-side by the larger wheel of the side frame, from which a reciprocating

motion is imparted to the cutters by suitable gearing. The principal points in which this machine differs from the preceding one are, that a different arrangement of cutting apparatus is adopted, and the rotating reel is dispensed with. The cutting apparatus consists of a series of small cutters, of a lancet or triangular form, with sharp edges, affixed to a reciprocating bar, which occupies the place of the cutting-blade in the other machine, and is worked in like manner from the axle of the larger running wheel. To the front edge of the platform are fixed as many prongs or tines as there are cutters; these prongs are doubled or bent back again upon themselves, and thus form spaces through which the cutters may pass; and, when the machine is in motion, the several cutters alternately pass from the centre of one prong to the centre of the next and back again, so as to act with such prongs in the manner of the moveable and fixed jaws of a pair of shears, and cut through the stalks of corn which enter between them. An attendant sits upon the side frame, and, with a peculiar kind of rake, he pushes off the cut corn, in quantities equal to the size of a sheaf, from the back of the machine, instead of from the side, as in the former case. The head of the rake, in which the teeth are inserted, is of the ordinary form; but the handle, instead of standing out at right angles to the side of the head, is fixed in an inclined position (sidewise) to the top of the same. The action of the attendant, when using the rake, is similar to that of a man paddling at the side of a canoe. The man or boy who drives the horses does not sit on the machine, but rides the near-side horse, in the manner of a postilion.

Messrs. Garrett and Son contributed a reaping machine of their manufacture, termed the "Tollemache corn-reaping machine," from its introduction into this country from the United States by J. Tollemache, Esq., M.P. Its construction, with some modifications, is similar to that just described. The machine is drawn by two horses, placed one before the other,—the hind horse working in a pair of shafts, affixed to the side frame, which is, in this instance, on the near side of the platform; whereby the boy that drives the horses is enabled to walk at the near side of them (as usual) on the land from which the corn has been cut; and this he could not do if the frame were on the off-side, as in the two preceding machines.

This machine, like the others, was tried publicly last harvest; and, with the addition of a tail-platform, was found to act very satisfactorily,—delivering the corn out at the side instead of the end of the machine. Some credit is due to

Messrs. Garrett for being the first to re-introduce, if we may so say, reaping machines to the public; and also for resisting an attempt which was recently made to impose a tax on the public by means of a patent right for the use of some improvements, the benefits of which they had previously given to the world.

Mr. Blaikie, of 71, Stockwell-street, Glasgow, exhibited a model of a reaping and mowing machine, consisting of a horizontal metal frame, of a triangular form, which carries two long straight blades or knives, affixed to the sides thereof, and meeting at the forward end of the triangle, from which a bent piece of metal, resembling the front end of a skate-iron, depends, for the purpose of preventing the end of the frame from ploughing into the soil. The frame is suspended from a pair of large wheels, which travel within it. Behind the machine there is a pair of reversed shafts, in which a horse is placed and connected thereto, so as to push the apparatus onward, and thereby cause the two knives to come in contact with and cut down the corn on either side of the machine. The shafts are affixed to the end of a long bar, which is connected to the axle of the running wheels by a centre-pin; and to a short extension of the bar, beyond the pin, is fastened an upright rod, with a pair of handles at the top; by means of which, the attendant, who sits in a seat directly over the axle, can guide the machine.

Among the French agricultural implements, there was a model of a reaping and mowing machine, which, from its construction, formed a connecting link between the preceding ones and those of the rotary class, which we shall presently describe. The frame of this machine takes the form of a right-angled triangle,—the inclined side of the triangle constituting the off-side of the frame. It is supported by a small wheel or roller at the fore part, and by a pair of large wheels at the back, where it is also furnished with a pair of handles, by which it is pushed forward. To the near side of the frame, midway between the fore-wheel and the near hind-wheel, is attached a horizontal tapering knife; and a similar horizontal knife is fixed to the same side of the frame, in such a position as to form, with the other blade, an angle of about 60° ;—the two knives presenting an appearance similar to that of a pair of scissor-blades, opened ready for cutting. Above the first-named knife, a vertical spindle is supported by the frame; rotary motion is imparted to it by gearing connected with the hind-wheels; and two curved horizontal blades, which it carries, are thereby caused to act with the fixed blades in the

manner of shears, and cut through the stalks of the corn standing between them. A horizontal rod or bar extends from the back part of the frame, on the near side, nearly at right angles thereto, and carries a blade, which projects backward towards the frame: it is apparently designed to lay the cut corn in rows or swathes ready for binding.

Mr. Taylor, of Bury, Lancashire, exhibited a small machine for cutting corn, designed to be worked by hand. It consists of a low wooden carriage, mounted on four small wheels; at the centre there is an upright spindle, supporting a plate or disc, from which a horizontal arm projects through a long opening in the fore part of the carriage; and, to the outer end of the arm, is affixed a scythe, furnished with a "cradle" for laying the cut corn in rows for binding. On the top of the spindle there is a cross-bar or handle; by means of which, the operator causes the scythe alternately to move through the half of a circle—cutting down all the corn in its path—and then to move back again into the proper position for commencing a fresh cut. By means of suitable gearing, connecting the upright spindle with the small running wheels, the carriage is made to travel onward a short distance during the backward movement of the scythe.

A model of a simple rotary mowing or reaping machine was contributed by Mr. Mackay, of Swansea. The framing of this implement is suspended from the axle of a pair of running wheels, and is furnished at the back with a pair of handles; at the lower part of the frame there is a cutting-blade (shaped somewhat similar to an S, or, as it may be termed, a double scythe), affixed to a short vertical shaft, connected by wheelwork with the axle of the running wheels; and, therefore, as the machine is impelled onwards, the blade or scythe is caused to rotate and cut down the standing corn which it meets in its progress.

Mr. Fairless, of Corbridge, Northumberland, exhibited a machine of a similar character to the preceding one. In this instance, however, the frame is mounted on four low wheels, and to the hinder part of it is attached a pair of shafts, in which a horse is placed in a reverse position, so as to push instead of draw the machine. At the front of the frame there is a vertical spindle, to which motion is transmitted by gearing from the axle of the fore-wheels; and, to the lower end of the spindle, a horizontal arm is fixed, at the middle of its length, for the purpose of carrying, at each end, a curved horizontal blade, which, as the spindle revolves, cuts down the corn.

A model of a machine for reaping corn was deposited in the Exhibition by Mr. Trotter, of Bywell, Stocksfield, near Gateshead. It consists of a long rectangular wooden frame, carried by a pair of hind-wheels and a single swivel fore-wheel. At the centre of the machine there is a revolving vertical shaft, cranked at the lower end; upon the shaft, above the crank, is fixed a frame, consisting of a boss, with four arms projecting radially therefrom; and, on the crank-pin, is fitted another boss with four radial arms: therefore, as the shaft revolves, the frame carried by the crank-pin will move eccentrically to the first-mentioned frame. The corn is cut by four straight double-edged knives; each knife being affixed at the butt-end to a short upright stem, cranked at the top. The stem is carried by an arm of the lower frame, and its crank-pin is connected to the end of an arm of the upper frame; and thus a kind of parallel motion is produced, that causes each knife, as it is successively brought by the revolution of the shaft to the side of the machine, to assume a suitable position for cutting down the corn standing in its way.

Mr. Winder, of Ingram-court, Fenchurch-street, contributed a model of a machine for reaping corn or mowing grass, having a frame like an ordinary cart-frame, running on two wheels, and impelled by either one or two horses at the back. The wheels are affixed to separate short axles; and the inner ends of the axles are connected by wheelwork with the vertical spindles of two horizontal circular knives or cutting-discs. Motion is thus transmitted from the travelling wheels to the circular knives, which overlap each other, and act like rotary shears to cut the corn or grass near the surface of the earth. The two projecting parts of the frame, that carry the spindles of the knives, are furnished with upright bent metal plates or guides, by which the cut corn is caused to fall in the space between them, and to lie on the ground in rows or swathes. Between the guides there is a horizontal metal plate, with a ridge along the centre, which assists in guiding the cut corn.

A model of a mowing and tedding-machine was shewn by Messrs. Beckford and Gosling, of Highfield Farm, Henley-on-Thames. This apparatus is designed to perform, simultaneously, the operations of mowing grass and making hay; or either part of it may be put into action independently of the other part. The body of the machine is carried by a pair of large hind-wheels and a single swivel fore-wheel, and is furnished, in front, with a pair of shafts for a horse. On the off side of the body is the mowing apparatus, consisting of a low metal cylinder, with a ledge at the bottom, from

which four curved blades project horizontally; and the requisite rotary movement, in order to cut the grass, is imparted to the cylinder and blades by gearing from the off side hind-wheel. In order that the height at which the curved blades cut the grass may be regulated, the vertical spindle of the cylinder is connected to the end of a lever that turns on a horizontal axis or fulcrum, and the other end of the lever is extended beneath the seat of the driver, who, by pressing on the end of the lever with his foot, can raise the knives to the desired height. The hay-making apparatus is situate on the near side of the machine; it is of the ordinary construction, consisting of a revolving cylindrical frame, with six rows of projecting teeth, which catch and throw over the grass; and motion is communicated to the axle of the cylindrical frame by gearing from the near side wheel.

Implements for mowing lawns, pleasure-grounds, &c., constructed on the plan invented by Mr. Budding, were contributed by Messrs. Ferrabee and Sons, Ransomes and May, Cottam and Hallen, Richmond and Chandler, and Shanks and Son. Budding's grass-cutter consists of an iron frame, somewhat resembling a sack-barrow, but running upon a large iron roller, instead of a small pair of wheels, when it is pushed forward by the attendant, who grasps the handles at the upper end of the frame. Across the lower end of the frame a straight blade of steel is fixed in a horizontal position; above this blade there is a rotary cutter, consisting of a horizontal spindle, carrying three rings, whereon several helical cutting-blades are fixed; and this helical cutter, being caused to rotate by gearing from the axle of the roller, acts with the fixed blade in like manner to the apparatus used for shearing cloth, and cuts the grass which comes in contact with the fixed blade as the apparatus moves forward. The height at which the grass is cut is regulated by a small roller, attached to the frame, and travelling on the ground between the large roller and the cutters, so as to support the straight cutting-blade at the desired elevation above the surface;—the bearings of the roller being adjusted by set-screws for that purpose. The grass, as it is severed by the cutters, is delivered into a shallow box, affixed to the fore part of the frame; so that none of the cut grass is left upon the lawn. This implement may be used by persons who have not the slightest knowledge of the art of mowing; it leaves neither seams nor bare places, which frequently result from the use of the scythe; and, as the grass can be cut by it when dry, it may be employed at any time.

In concluding our analytical sketch of the reaping and mowing machines contributed to the Crystal Palace, we may remark, that, besides affording an opportunity for the display of many new and ingenious contrivances, calculated to assist the farmer in the performance of a very arduous and important operation at a time when he is the least able to obtain manual assistance, the Great Exhibition has also been the means of drawing attention so prominently to the subject of applying machinery to this the only operation on the farm that is solely dependent on manual labor, that there is little danger of the labors of ingenious inventors in this branch of the mechanical arts being a second time neglected and lost to the public. On the contrary, we have every reason to hope that, before many harvests are past, reaping and grass-cutting machines will be in as general use as the thrashing machine, and that the sickle and the scythe may be hung up, in company with the flail, as a remembrance of the past.

INSTITUTION OF CIVIL ENGINEERS.

February 17 and 24, 1852.

The discussion on Mr. W. B. ADAMS' paper, "*On the permanent way of railways*," occupied the whole of these evenings.

The importance of diminishing the cost of maintenance of way was admitted by all the speakers, and numerous improvements introduced for that purpose were mentioned. Those which appeared to have obtained the most general approval were, Mr. Fowler's long chair; Messrs. Adams and Richardson's fished joints; Mr. Samuel's fished chairs; Mr. P. W. Barlow's cast-iron sleepers; and Mr. W. H. Barlow's self-supporting, broad-flanged, wrought-iron rails. Each of these systems were shewn to possess peculiar qualities; but it appeared to be admitted that the latter combined the greater number of advantages, now that the more powerful machinery of the iron works enabled heavy rails to be rolled with greater facility and at a less cost. The asserted rigidity of the iron lines, without timber sleepers, was combatted; and it was stated that, from the evenness of the joints, the wear and tear of the rolling stock would be diminished, the cost of maintenance of the permanent way would be materially reduced, and that provision against the effects of the contraction and expansion of a long length of rails rivetted together need not be made, as in practice the anticipated effects were not experienced.

It was stated that the system of fishing the joints had been practised in Germany for some time, and that as far back as 1838,

rails with a hole at each end had been exported from this country ; it appeared, however, to be the general opinion that these holes were not intended for fishes, but for traversing pins to hold down the ends of the rails in the joint chairs ; however, within the last few years the system of fished joints had been introduced with great advantage in Germany.

The numerous varieties of form proposed by Mr. Adama, for inflexible girder-rails, for hollow iron sleepers, for a combination of timber and stone bearings, &c., were discussed ; the system of accumulating all kinds of assumed forms was censured as having a tendency to retard the introduction of improvements by practical engineers ; and the compound rails were objected to as being less substantial at first, and more expensive to renew than Barlow's rail,—which, when exfoliated on the surface, could be again rolled at a cost of less than 2*l.* per ton. The other modifications were not considered to be required ; as with the present experience in railway affairs, with good materials, care in putting them together, and keeping the whole in order, a good travelling road might be made and maintained on any of the usual systems. Up to the present time, a strong bridge-rail, firmly secured to a strong longitudinal balk of timber, soundly packed with dry gravel ballast, and well drained, had been admitted to be, if not the best, at least one of the best kinds of permanent way. It remained to be demonstrated by time what amount of improvement was introduced by the continuous broad-flanged rail, which it was admitted did appear to be well adapted for foreign lines ; but with respect to them it was contended, that in almost all the tropical climates there were some kinds of timber which resisted the white ant, and those would necessarily be used ; but it was probable that the use of iron might be found ultimately more economical, even if it were more costly at the outset.

On the question of stone block railways, it was urged that on several lines so constructed, where the traffic was considerable, but where the velocity did not exceed ten or twelve miles per hour, the rails lasted well, and the cost of maintenance of way was light ; but that where the velocity was great, the rigidity was objectionable, and caused too much wear and tear of the rolling stock.

In the various statements of the cost of maintenance of way, it was essential to specify what items were included in each, in order to arrive at any comparison. When iron was cheap, and timber comparatively dear, the proposed system of cast-iron sleepers and of very heavy continuous rails might be advantageously adopted ; but in countries where timber was abundant and iron must be imported, the system of longitudinal timber sleepers and light rails would of necessity be adopted.

With respect to the cast-iron sleepers on the South Eastern Railway, it was stated, in reply to questions asked, that there was not a greater amount of breakage than with ordinary cast-

iron chairs; although the system had been principally tried on a part of the line where the traffic was very heavy and the ballast was very bad; and that the offer of Mr. Taylor, the contractor, to maintain and renew those parts of the line laid with cast-iron sleepers, for twenty-one years, for 100*l.* per annum, sufficiently proved the fact.

It was urged also, that it was impossible to draw any accurate deductions from the expenditure in maintaining a wood sleeper line for six months, as it might appear in the next half-year that an apparent saving had been made at the expense of increased deterioration.

It was urged, that the duration of rails must depend on the quality of the iron, the proportion of its weight to the traffic, and the velocity and amount of that traffic. That the question of the cost of maintenance of way was, up to the present time, almost an insoluble problem; the elements being inconstant—no absolutely parallel cases being in existence; and unless all the conditions were distinctly given, no comparison between different systems could be established.

March 2nd.

The first paper read was, "*On the electric telegraph, and the principal improvements in its construction.*" By Mr. F. R. WINDOW, Assoc. Inst. C.E.

After a brief notice of some of the early systems of telegraphs employed by the ancients, such as beacon fires, and the escape of water from perforated vessels, as described by Polybius, and also a few of those of modern construction, such as Amonton and Chappe's semaphores and the universal telegraph invented by Major-General Sir Charles Pasley,—a description was given of some experiments, made in the last and present centuries, on the possibility of transmitting electricity to considerable distances, with the view of adapting this power to telegraphic purposes. Among these were mentioned the experiments of Du Fay, who, in France, in the year 1733, discharged a Leyden jar through upwards of four miles of wire; of Winckler, who, at Leipzig, in 1746, discharged a Leyden jar through a long wire—a portion of the river Pleiss being included in the circuit; and of Dr. Watson, who, in 1747, suspended a length of two miles of wire on posts at Shooter's-hill, and sent electrical currents through it,—the circuit being completed by the earth. This was particularly noted, because in all the earlier inventions of the present century a separate wire was reserved for this purpose.

The general existing system of electric telegraphs was then examined, and divided by the author into three distinct departments:—1st, the battery or the motive power; 2nd, the wires and their insulation, or the means of conveying the power to the

place of its action; and, 3rd, the instruments, or the means of using the power. Of the two former there was little to be related, inasmuch as they had received scarcely any attention from inventors, which the author regretted, as he thought these departments offered the widest field for substantial improvement.

The ordinary voltaic batteries were then described, together with the method of obtaining electricity from the permanent magnet, as employed by Cooke, and by Henley, and the manner in which it was adapted to the use of the telegraph. The means of insulation were mentioned as specially needing reform;—the present above-ground system being uncertain and imperfect in its action, and the under-ground systems too expensive in their construction. It was explained, that the object of Mr. Edwin Clark's metallic capped insulators was to prevent dew from being deposited upon the porcelain cups, as was always the case from the good radiating qualities of all non-conductors. The invention consisted in surrounding the insulators with a metallic substance, by which, from the bad absorbing properties of metals, the radiation from the porcelain was greatly checked, and it was thus prevented from cooling down below the dew point. A short description was then given of the principal existing instruments: amongst which were Cooke's five needle, Cooke and Wheatstone's double and single needle, Wheatstone's indicating, Bain's chemical decomposition, Henley's magnetic, Brett's printing, and Bakewell's copying telegraphs.

The paper concluded by asserting, that the present systems of electric telegraph must by no means be considered as perfect, and inventors were recommended to turn their attention to the improvement of the batteries, and the means of insulating the wires, rather than to the production of new instruments, in which division it was stated, that improvement could probably be carried little further, until some important changes were effected in the other two departments.

The second paper read was, "*The history, theory, and practice of the electric telegraph.*" By Mr. C. C. ADLEY.

The first portion of the paper contained a description of the various modes of transmitting signals proposed and adopted prior to the electric telegraph. The plans of Cardinal Bembo, the Marquis of Worcester, Robert Hooke, Amonton, Marcel, Linguet, and Chappe, were noticed.

The various forms of telegraphs, in which electricity was the exciting cause, were then described. These were divided into two eras, the electrostatic and electrodynamic. The electrostatic era comprised all telegraphs in which statical or frictional electricity was the acting principle, such as the plans of Odier, Lesage, Lomond, Betancourt, Reiser, Cavallo, Salva, and Ronalds. The electrodynamic era included all telegraphs in which voltaic

or dynamic electricity was the prime mover, as were the telegraphs of Sæmmerring, Schweiger, Wedgewood, Coxe, Ampère, Dyar, Schilling, Gauss, Alexander, Wheatstone, &c., &c. This brought the chronology of the electric telegraph to the year 1837, and the history was then concluded to the year 1851, by a classified list of the various patents.

The second part of the paper was devoted to the theory and practice of the electric telegraph; and the subject was enlarged upon under the following heads:—1st, the principles adapted; 2nd, the materials employed; 3rd, practical difficulties and remarkable deranging causes, with investigations as to their origin; 4th, the laws which govern the action of the telegraph; 5th, theories of the mode of transmission of the electric fluid and of the earth-circuit; and, 6th, practical applications and concluding remarks. These heads were again subdivided, and the various portions of the telegraph were treated of separately. The modes of connecting the instruments at the stations were given in detail, together with several practical rules for detecting faults, and for the general manipulation of a line. Various defects which occurred in practice were pointed out, and the consideration of remedies was invited.

The action of the Aurora Borealis, the demagnetization of the needles by lightning, and their frequent derangement by other disturbances, were noticed.

A lengthened and elaborate investigation was entered into, with a view of arriving at the origin of the periodic disaffections of the magnetic needles, which the author attributed chiefly to the electric variations of the atmosphere, magnetic storms, earth currents, thermo-electric currents, and caloric. An original law which governed the deflections of the magnetic needles, was introduced by the author. The laws of Professors Wheatstone and Ohm were also given, as well as the theories of Dr. Faraday, Magrini, Gauss, and other philosophers.

The various applications of the electric telegraph were then described, such as—1st, for printing; 2nd, for working a series of clocks isochronously together; 3rd, for the comparison of the pendulums; 4th and 5th, for registering meteorological observations; 6th, for producing explosions for blasting; 7th, for comparative astronomical observations; 8th, chronoscopes, for measuring the flight of cannon balls, &c.

After citing proofs of the commercial value and public service of the electric telegraph, the paper concluded with a few observations as to the ultimate destiny and world-wide utility of so wonderful an invention.

March 9th and 16th.

At the discussion following the two papers on the electric telegraph, by Mr. Window and Mr. Adley, the various instruments

introduced by Messrs. Cooke and Wheatstone, Henley, Brett, Bain, Bakewell, and Siemens were exhibited and fully explained.

The system of under-ground wires, coated with gutta-percha and lead, as introduced in Prussia by Mr. Siemens, in 1848, was stated to be perfectly successful; no difficulty existing in discovering leaks or injuries to the wires; and when any occurred, which was very seldom, they were easily repaired. The system now extended over nearly four thousand miles in Prussia and Russia.

It was objected, by Professor Airey, that the nomenclature was incorrect, and that, instead of the "electric," it should be called the "galvanic" or the "voltaic" telegraph, as the connection between electricity and galvanism was not as yet clearly established. The use of a series of wires was suggested for tracing the causes of magnetic disturbances; and series of observations at stations along lines were proposed as likely to induce beneficial results: they could be easily performed, since the introduction of the photographic self-registering instrument. The important results likely to be rendered by the connection of the telegraphic wires with the Royal Observatory at Greenwich, were stated to be, among many others, simultaneous astronomical observations; the determination of difference of longitudes; and the isochronous action of clocks, so as to exhibit Greenwich, or any other time agreed on, simultaneously at any number of clocks throughout the kingdom.

The practical difficulty of the perfect insulation of the wires, in the over-ground system, and the provisions necessary against wanton depredation, and the atmospheric influences, were fully discussed; and it was generally acknowledged that, with all the known imperfections, the over-ground system had hitherto proved the best and most economical in England; at the same time the great merit of gutta-percha, as a means of insulation, was fully admitted.

It was shewn that galvanic action was being extensively used in Berlin, for communicating between the various government offices and the fire and police stations; and at Boston, U.S., for a complete net-work of fire alarms to the different stations of the engines.

The origin of the idea of the submarine telegraph was given; and the construction of the wire laid down between England and France was described. It appeared, that on that line the common needle instrument had hitherto been generally used, but that occasionally messages were recorded by means of Brett's printing telegraph, which might eventually be made very useful.

On the second evening, the discussion turned chiefly on the comparative advantages of the under-ground system of connecting wires, as practised in Prussia, and the suspension system in use in this country. At the first introduction of the electric telegraph, it was not known to what extent it would be employed;

and on that account the suspension system was preferred, as enabling additional wires to be fixed with but little extra expense. At present, a single line of telegraph wire in Prussia, insulated by gutta-percha covered with lead, laid at a depth of two feet under ground, cost 30*l.* per mile, inclusive of the instruments. The suspension system was shewn to be less expensive, and when accidents occurred, they were more rapidly and easily repaired. The recent great improvements in Bain's printing telegraph were described; and it was shewn that by it three hundred words per minute had been sent through this instrument; that fifty-six thousand messages per month had been transmitted on the Eastern Counties Railway, for railway purposes alone; and that such was its extended use for mercantile purposes, that the contents of a closely-printed octavo volume was sent out in messages, per day, from the Central Telegraph Office alone. Such was the facility afforded by the instruments now in use, that they were chiefly worked by boys taken from the Orphan Asylum, who fully understood how to work them after a fortnight's practice.

Several very ingenious applications of the instruments were described; and specimens of the submarine telegraph wire, intended to be laid down between Dover and Ostend, were exhibited.

The general advantages of the introduction of the electric telegraph were pointed out, and it was stated that attention should be directed chiefly to improvements in the mode of insulation of the wires, in both the under-ground and the suspension systems, as the instruments were now comparatively perfect.

SOCIETY OF ARTS.

January 28th, 1852.

On machines and tools for working in metal, wood, and other materials. By the Rev. ROBERT WILLIS, M.A., F.R.S., &c., Jacksonian Professor in the University of Cambridge.

THE lecturer prefaced his discourse, by remarking that the Exhibition was made up of *natural materials, artificial products, and processes*, by which the first are converted into the second; and that the processes and the machines connected therewith, which formed the subject he had to speak of, could not, from their very nature, be adequately represented in the same building; as many required opposite conditions of atmosphere, and were noisy, and otherwise offensive; while some labored under the disadvantage of being wholly unintelligible without the aid of experimental explanations, and would therefore have been altogether out of place in a public exhibition. For these reasons, it is more difficult to trace the effects that may be expected in the department under review than in the other branches of the collection. But there are two very desirable objects, which, if we

take advantage of the interest excited on the subject of manufacturing science and art by the Great Exhibition, we may possibly succeed in bringing to bear.

The first object is to effect a more intimate union and greater confidence between scientific and practical men, by teaching them reciprocally their wants and requirements, their methods and powers, so that the peculiar properties and advantages of each may be made to assist in the perfection of the other. The second object is to promote a more universal knowledge amongst mechanics and artisans, of the methods and tools employed in other trades than their own, as well as of those employed in other countries in their own and other trades.

With respect to the first object, the lecturer remarked, it is no secret that there has always existed an unfortunate boundary wall or separation between practical and scientific men—a mutual distrust or misunderstanding of their relative values, which has deprived them of many great benefits that they might have mutually derived from each other's pursuits. It is true that, in many branches of science—as in chemistry, geology, and botany—this barrier has, to a great extent, been broken through: the practical man has found the benefit of scientific generalisations; and the theorist has been compelled to seek the facts upon which his theories are to be based, in the mines and manufactories;—thus compelling the two classes to work together, and learn to understand each other. Still there remains too much of the ancient contempt for “theory,” and of an overweening and conceited value for “facts” and “practice.” In no department of science is this carried to a greater extent than between the mathematical and practical mechanics; and yet the mental process by which the parts of a complex machine are contrived and arranged in the brain of the inventor requires the geometrical faculty, as it is called, to a very high extent: that is to say, the power of conceiving mentally the relations of the parts of complex figures in space. So that, in truth, a man gifted by Nature as a mechanist, is also qualified as a geometrician; and the untaught inventor, struggling to give form and reality to his conceptions of a new machine, is, in reality, practising imperfectly and unknowingly the very geometrical science he despises, and which, if he had acquired its elements, would at once have shewn him how to systematize and arrange his ideas.

He next proceeded to speak of machines for working in metal, wood, and other materials.

The object of such machines, he said, is to work rough material into shape; which may be done in three different ways:—
1. By abrading or cutting off the superfluous portions in the form of chips or large pieces. 2. If it possess ductility, we knead it, or press it into form in various ways; as by hammering, rolling, drawing, &c. 3. If it be fusible, we melt it, and pour it into a mould. The most interesting series of machines is that

which belongs to the first group; and to this the lecturer confined his remarks. Machines of this kind, he said, are either general, like the lathe or the planing-machine, which are used for a great variety of purposes, or they are especially adapted to the production of a single object of manufacture: in the latter case, they are often contrived in a series,—as the block-machinery, the machines for making cedar pencils, and the like; and the introduction of such especial machines is of great importance, and has certainly not yet reached its limits. As the machines of this latter kind are commonly modifications of one or other of the first, the history of the two must be considered together.

The origin of the turning lathe is lost in the shades of antiquity; and the saw-mill, with a complete self-action, turned by a water-wheel, is represented in a MS. of the thirteenth century at Paris, and is, probably, of much earlier contrivance. The lathe was, in process of time, adapted to the production of oval figures, twisted and swash-work (as it is called), and, lastly, of rose-engine work. The first real treatise on turning is Moxon's (1680), which gives us a valuable picture of the state of the art at that period, and he has preserved to us the name of the engine-manufacturer of that day—Mr. Thomas Oldfield, at the sign of the Flower-de-Luce, near the Savoy, in the Strand—as an excellent maker of oval engines, swash-engines, and all other engines: which shews that such machines were in demand. A few drawings of such machines occur in earlier works, beginning with Besson, in 1569. From the treatise of Plumier, published at Lyons in 1701, we learn that turning had long been a favourite pursuit in France with amateurs of all ranks, who spared no expense in the perfection and contrivance of elaborate machinery for the production of complex figures. In our own country, the literature of the subject affords us only a few scattered hints as to the progress made during the seventeenth and eighteenth centuries.

Smeaton has recorded that, in 1741, Hindley, the clock-maker, of York, shewed him a screw-cutting lathe with change-wheels, by which he could, from the one screw of the lathe, cut screws of every necessary degree of fineness, and either right or left-handed.

But the clockmakers, to which body Hindley belonged, were the first who applied *special machines* for their manufactures. Their wheel-cutting engine has been ascribed to Dr. Hooke, about 1665, and its use rapidly spread over the continent. The gradual improvement of this machine, and the successive forms which it assumed as the art of construction was matured, forms a very instructive lesson. But herein our own countrymen have largely contributed to its perfection. Henry Sully, an English clock-maker, who removed to Paris about 1718, carried with him, among other excellent tools, a cutting-engine, which excited great admiration there. The form of the present French engine is, however, derived from Hulot's machine (about 1763). But our English engine (in which the dividing-plate is superseded by a train of change-wheels, so contrived as to require an entire turn

of a latch-handle for each shift, and thus secure against error) is derived from Hindley's engine, which he shewed to Smeaton in 1741, and which finally passed into the hands of Mr. Reid, of Edinburgh.

The fusee-engine, which is another special clockmakers' machine, must have greatly contributed to the perfection of machines for working in metal.

But the next great step towards the perfection of machine tools was the slide-rest. The slow and gradual way in which this device acquired the form in which it now exists, is very curious. Although, as early as 1648, Maignan published at Rome engravings of two curious lathes for turning the surfaces of metallic mirrors for optical purposes, in which the tool is clamped to frames, so disposed, that when put in motion it is compelled to move so as to form true hyperbolical, spherical, or plane surfaces, according to the adjustment; and although the fusee-engines, screw-cutting lathes, and other contrivances already alluded to, employed tools guided by mechanism, yet the real slide-rest does not make its appearance until 1772, when, in the plates of the French "Encyclopédie," we find complete drawings and details of an excellent slide-rest, nearly identical with that usually supplied by lathe-makers.

As an early example of the application of machinery to manufactures, we may record that Bramah, in 1784, obtained a patent for his admirable lock, and immediately set about the construction of a series of original machine tools for shaping, with the required precision, the barrels, keys, and other parts of the contrivance. In his workshop was educated the celebrated Henry Maudslay, who appears to have worked with him from 1789 to 1796, and was employed in making the principal tools for the locks.

Foremost among the ingenious persons who carried on this great movement must be recorded Brigadier-General Sir Samuel Bentham. It appears, that in 1791, no machinery, other than turning-lathes, had been introduced for working in wood,—excepting that some circular and reciprocating saws and working tools had been applied to the purpose of block-making by the contractors who then supplied blocks to the navy: even saw-mills for splitting timber, though in extensive use abroad, were not to be found in this country. General Bentham had, at this time, made great progress in contriving machinery for shaping wood, as is sufficiently shewn by his remarkable specifications of 1791 and 1793; and he informs us that, rejecting the common classification of works according to the *trades* or *handicrafts* for which they are used, he *classed the several operations that have place in the working of materials of every description according to the nature of the operations themselves*; and, in regard to wood particularly, contrived machines for performing most of those operations,—whereby the need of skill and dexterity in the workman was dispensed with, and the machines were also capable of being worked by a steam-engine or other power. Besides the general

operations of planing, rebating, morticing, sawing in curved, winding, and transverse directions, he completed, by way of example, machines for preparing all parts of a sash-window, and of a carriage-wheel; and actually shewed these and other machines in a working state in 1794, in London.

This led to his appointment as Inspector-General of Naval Works, for the purpose of introducing these, and various other machines, into the Royal dockyards, which he immediately set about effecting. In 1802, the General received a most powerful and efficient auxiliary in the person of Mr. Brunel, who, in that year, presented his plans for the block-making machinery. His services being immediately secured, and Mr. Henry Maudslay engaged for the construction of the mechanism, the admirable series of machine tools was finished and set to work in 1807, by which every part of the block and its sheaves are prepared.

One of the most useful machine tools that made its appearance at the end of the eighteenth century, was the circular saw. This had been applied to cutting metal on a small scale—as in the cutting-engine, ever since the time of Dr. Hooke. Where or by whom the woodcutter's saw was put into the form of a revolving disc, has not been recorded. It found its way into this country about 1790,—some say from Holland—and was employed at Southampton, and elsewhere, in wood-mills.

After the completion of the block machinery, it becomes very difficult to trace the subsequent improvements. The art of machine-making for working in metals was gradually advancing, but is not recorded in patents, and very little described in books. The slide-rest principle was extended, large self-acting lathes constructed, and boring machines of great precision and improving structure were called into existence by the necessity for extreme accuracy in the cylinders of steam-engines.

No greater proof of the obscurity which hangs over the history of machine tool-making, in the first half of this century, can be given, than the unknown origin of the planing-machine for metal. This machine made its way into the engineering world silently and unnoticed; and, some years afterwards, when its utility became recognized, and men began to enquire into its history, various claimants to the honor of its invention were put forward. We can only learn that, somewhere about 1820 or 1821, a machine of this kind was made by several engineers. Messrs. Fox, of Derby, and Roberts, of Manchester, appear amongst the number; and the forms which they gave to the engine have remained permanent. Mr. Clement has also been mentioned, as well as others.

The mortising-engine of the block machinery was applied by Mr. Roberts, of Manchester, to the formation of the key-ways of cast-iron wheels, and also to the paring, or planing by short strokes, of the sides of small curvilinear pieces of metal, such as cams, short levers, and other pieces that do not admit of being finished in the lathe. Thus, under the name of *slotting and paring-machine*, a new and generally useful machine-tool sprang

Germany furnished a portable universal instrument by Briel and Sons. This was a beautiful instrument, intended by its maker to combine the greatest possible simplicity with the greatest possible firmness: its clamps were applied in all cases to the centre, to prevent the bending of the spokes or affecting the figure of the circle. The work of this instrument in every respect was found to be very good,—the divisions were fine, clear, and distinct.

A portable equatoreal, of good workmanship, was forwarded by Merz, of Munich, who, by not forwarding a more original and valuable instrument, did not do justice to himself or German work, which was not properly represented in the Exhibition,—for Germany by no means put forth her strength.

The divisions on both these instruments were fine specimens of hand-dividing; and when it is considered that this operation requires the operator to be in a darkened room for weeks together, involving close application, of a most hurtful nature to his health, it is with much satisfaction we find that, beautiful as the divisions on Simms' instruments were found to be, they were the work of his self-acting dividing engine, and that the whole of the operations of dividing and cutting were performed by machinery, independent of any personal superintendence after the preliminary arrangements were completed. The application of this machine materially lessens the expense of instruments: thereby placing the pursuit of science more in the power of those who, earnestly wishing to be useful, could not with prudence incur too large an outlay in the purchase of instruments.

In the American department, Bond exhibited an apparatus for observing transits by means of a galvanic circuit. It consists of a break-circuit-clock, battery, wires, and a cylinder around which paper is wrapped. This cylinder is mounted on a delicate axis, furnished with friction rollers, and revolves once in a minute; the circuit is broken and restored by the seconds pendulum; so that sixty seconds are recorded on one line; and there are sixty lines on each sheet of paper. The armature of the electromagnet carries a glass pen, supplied with ink from a small reservoir; and the records are made as the paper revolves under this pen. In ordinary transit observations, the observer takes a second from the clock-face; counts the beats whilst the object passes the wires; records these times by the clock to the tenth part of a second; writes them in a book, still counting the beats of the clock; and, after the transit of the last wire, continues counting on till he can look at the clock-face. But, in the new method, the coincidence of the wire and the object is noted; at which instant a key is touched with the finger—this touch causing an impression to be made on the recording apparatus of a dot, if the touch be momentary; of a series of dots, separated by equal spaces, if the intervals of time between successive touches be equal; of lines of different lengths, if the times of pressing the

key be variable; of equal lengths, if the times be of equal duration, or at equal intervals. In this manner may be generated a series of dots, lines, and blanks, of all varieties of lengths. Lines of equal length, or spots equi-distant, may be registered by the movement of a clock alternately making and breaking the circuit, as well as by the finger of the operator; and lines or spaces may be made, corresponding to intervals of one second; and thus the clock be made to mark seconds of time. If, then, an operator should make contact at the instant of the occurrence of any phenomenon, as that of a star passing a wire, one of these spaces would be broken; and it is easy to estimate the tenth of a second at which the contact was made; and hundredths of a second may be estimated by the use of a transparent scale, whose length, just equal to that of one second on the paper, is divided into ten parts, and made to cover the whole second.

Of ordinary Nautical Instruments, the American Department was said to furnish a fine collection, by Ericssen, mostly of a new construction; and also a very ingenious compass by St. John, a full description of which is given at p. 249, *ante*.

Instruments for levelling and surveying were furnished by England, France, and Belgium—generally well made, but not exhibiting any novelties or excellencies. Germany furnished several, all well made, in which Breithaupt's useful method of covering the divisions with a thin plate of brass, for the purpose of protecting them from dirt, oxidation, and mechanical injury, was generally adopted. Breithaupt himself exhibited a level with a contrivance for greatly facilitating its adjustments, and of great importance while surveyors continue to assume that the circular collars of a level are equal.

The Imperial Polytechnic Institution of Vienna exhibited some beautiful surveying instruments, constructed under the direction of Professor Stampfer. The greatest improvement was the means afforded for measuring a vertical angle of 8° , by which the difference of altitude between two stations, when greatly exceeding the length of the measuring staff, could be determined: an improvement of great value for work in a hilly country.

Russia furnished a well-made levelling instrument, and America (Burt) an instrument well adapted for surveying new countries—particularly in magnetic districts. It is applicable to the determination of time, latitude, and magnetic declination.

Mr. Andrew Yeates, of Brighton-place, New Kent-road, exhibited a prismatic compass, of simple construction, adapted for taking both horizontal and vertical angles, and so arranged that the former may be taken with the instrument held in the hand;—the object, the hair in the vane, and the magnetic bearing, being seen at once: it is adapted for fixing on a tripod; and a means is afforded of repeating the observation. It is also adapted for taking vertical angles. It is independent of the magnetic needle, and can be used in districts abounding in iron.

In speaking of optical instruments, the lecturer noticed a new kind of glass, exhibited by Mace (France),—its base being composed of the oxide of zinc and borax. It was extremely clear and free from color, and promises to be of considerable use in producing achromatic object-glasses of a very perfect description.

The Exhibition also made known a very fair attempt, by Wray, to substitute a solid substance instead of flint glass; which, as a step out of the beaten path, and towards the possible revival of fluid object-glasses, is meritorious.

The Rev. J. B. Reade exhibited two eye-pieces, which he terms solid eye-pieces, from the component parts being cemented together. As one was a little over-corrected, and the other a little under-corrected, it is plainly possible for a perfect achromatic eye-piece to be constructed on this principle.

The microscope, by the rapid advance in microscopic investigations within the last few years, has been enabled to vie in importance almost with the telescope. Since the introduction of achromatic combinations, physiological investigations have proceeded so rapidly, and our knowledge has increased so greatly upon animal and minute anatomy, that it was most gratifying to find so many superior instruments in the Exhibition. Those exhibited by Ross, and Smith and Beck, were beautiful instruments, and far exceeded any that were exhibited in the Foreign Section,—in which that of Natchez was decidedly the best. The British microscopes were distinguished by the great amount of light obtained, the large angle of aperture, and consequent fine definition; also by the large, flat, and perfectly-defined field.

There were two light-houses exhibited, both entirely of glass—the one by Chance, and the other by Wilkins: both were furnished with large Argand lamps, lenses, and reflecting prisms. As the object of light-houses is to transmit all the rays proceeding from the light in a horizontal direction, the reflecting prisms above and below the light were so placed that the incident rays on their second surface fell so obliquely that they were totally reflected horizontally: thus those rays which would have illumined the sky, and the waters of the ocean, were made available to increase the equatorial belt of light. The substitution of reflecting prisms, will, doubtless, supersede the use of metallic reflectors in light-houses generally.

There were a large number of barometers, thermometers, and other instruments intended for meteorological observations; but the greater part were of a very ordinary kind, and unsuited to the work intended.

The conditions of good thermometers were said to be best fulfilled in England by Messrs Negretti and Zambra, and in France by Fastré.

In maximum and minimum thermometers there was nothing new exhibited, although great need has long existed for an effective maximum thermometer. Thanks to the Exhibition, said the

lecturer, this want has since been supplied. The jurors, in the performance of their duties, dwelt upon the wants of science, and suggested, in some cases, how they might be supplied; and in this case, he (the lecturer) urged upon the exhibitors the great necessity of a new instrument to supersede the one now in use for the determination of maximum temperatures; and suggested that such might be constructed by introducing into the tube a piece of enamel or porcelain,—its end towards the mercury terminating in a blunt point, or otherwise, as experiment might determine: a form of instrument which has since been successfully achieved by Barrow, of Oxenden-street, and proved to be a great advance upon the old method, particularly for sun observations. But Messrs. Negretti and Zambra have invented another of a better kind, in which a small piece of glass is inserted near the bulb, within the tube, which it nearly fills: on an increase of temperature, the mercury passes this piece of glass; but on a decrease of heat, not being able to repass, it remains in the tube, and thus indicates the maximum temperature. After reading, it is easily adjusted. The lecturer had four of these instruments at work for upwards of a month—two in ordinary observations, and two subjected to severe tests—and all have answered admirably. Hitherto every series of meteorological observations has been more or less broken by the frequent plunging of the steel index into the mercury, or becoming otherwise deranged. Messrs. Negretti and Zambra have, in their maximum thermometer, supplied a want long felt.

M. Bourdon (France) exhibited barometers of an original construction, based upon the tendency possessed by a coiled and exhausted tube of thin metal to contract or elongate when subjected to variations of pressure. A description of this instrument was lately given in reporting the transactions of the Civil Engineers' Society. (See p. 521, vol. XXXIX.)

The collection of meteorological instruments in the Exhibition would lead to the conclusion that the conditions of good instruments are better understood and fulfilled by makers abroad than at home; but this, it is hoped, will speedily cease to be the case.

In speaking of photography, the lecturer noticed the works of Claudet, who exhibited applications of his focimeter; illustrations of the effects of the spectrum on the daguerreotype plate, as prepared by him; and pictures which, notwithstanding the loss of light necessary for the operation, were rendered non-inverting. He also spoke of Mayall, who exhibited the crayon daguerreotype, produced by a process of his own; Beard, who exhibited enamelled daguerreotypes, in which the permanence of the picture was secured by a lacquer; the pictures of Tyree, who claimed the adoption of a peculiar process of his own; and various others, which it would be tedious to enumerate.

As respects the paper and glass photography of the Exhibition, he said, the nearest approach to excellence of execution, combined with adherence to the rules of art laid down for the representation of natural objects, was made by Martens, in all of

whose works the elements essential to the process of the art, and to his own method, were so combined and applied, that the spectator, losing sight of the means in the end, beheld in them representations of the most perfect beauty, void of artificial effect or technical display.

Following Martens' steps—and inferior to him alone—were Bayard and Flacheron; and following after, many exhibitors of talbotypes and calotypes—among whose works were to be perceived specimens of M. Blanquart's process for the production of two or three hundred impressions from the same negative proof: their blotty and heavy appearance was, however, destructive, to a great amount, of the success of the results obtained;—their price was designed to vary from 5 to 15 centimes, according to their size.

In the British collection of sun pictures, some very beautiful results were obtained, by Ross and Thomson, of Edinburgh, upon aluminized glass. Mr. Buckle, of Peterborough, contributed calotypes of great beauty, by a process of his own; Hill and Adameon, talbotypes, spirited in effect and well toned; Henne-man and Malone, beautiful specimens, by Mr. Talbot's process, on paper, and some tinted by the application of caustic potash and a lead salt. Mr. Owen contributed a series of calotype pictures upon paper, so prepared by him that, by its use, he has been enabled to execute in a single day, in a journey of three hundred miles, ten large-sized talbotypes. Some good photographs were exhibited by Paul Pretsch, of Austria, and a few of a mediocre kind by the Zollverein; but they did not at all represent photographic art in their respective countries.

The lecturer next alluded very briefly to balances, calculating machines, electric telegraphs, and electrical machines; also to a beautiful machine, exhibited by Mr. Whitworth, capable of measuring to one-millionth of an inch.

In relation to acoustics, he said, the syrene of Cagniard de La Tour, exhibited by Watkins and Hill, was the only philosophical instrument exhibited. This beautiful instrument, the invention of the Baron de La Tour, he thus described:—The air set in motion, by blowing through a small tube, communicates motion to a circular plate, which turns upon a cylindrical brass chamber beneath. The plate, within its circumference, is pierced with a series of oblique and equi-distant holes, and immediately beneath, on the upper surface of the brass chamber, is a corresponding series. The obliquity of the two series of perforations is similar, but reversed, for the purpose of enabling the current to communicate a rotatory movement to the plate: the obliquity of the holes is in itself not necessary to the production of sound, but is a conventional arrangement to produce motion without the employment of an additional agent. The disc is thus made to revolve with a rapidity in exact proportion to the force with which the air is impelled through the tube, and, by its rapid and regular movement, gives to the external air a series of shocks, which produce a sound analogous to the human voice, more or

less sharp, according as the current turns the plate with more or less rapidity. The moveable disc is carefully centered in the surface of the air-chamber, by means of a slender axis working in a small orifice left for its reception, and is connected with the indexes above by a delicate cylindrical tube, terminated by an endless screw, which gives motion to a wheel furnished with 100 teeth, and bearing on its axle an index. A cog on this wheel acts upon another, whose axle likewise carries an index. For every 100 divisions traversed by the index of the wheel with 100 teeth (which corresponds with the same number of rotations performed by the plate beneath) one division is registered by the other of the two indexes—an arrangement which affords great facility for reading off the multitudinous vibrations of which each sound is composed.

If water be passed into the syrene instead of air, the same sounds are produced, even should the instrument be totally immersed,—the same number of vibrations producing the same sound: hence the name of the instrument.

This instrument in use, as applied to a continuous stream of air, is a means for determining the absolute number of vibrations in a second necessary to the pitch of a note, and may be set in motion by the flow of air or gas from a gasometer, or by a stream of water, as already mentioned; and is a beautiful and practical adaptation of a theory which it at once confirms, affording at the same time a key to much that is unknown in the relations existing between sound and its producing causes.

The lecturer, in concluding his address, remarked, that the fact of the scientific man being so frequently exposed to a life of unremunerated labor, urged him to express a hope, that at no distant time the pursuit of science in England may constitute a distinct profession, open to the preferments and advantages of other professions;—when the young man, ardent in his pursuit of natural laws and abstract science, shall work on patiently and contentedly, successively attaining those steps in his career marked by public epochs of encouragement, until, arriving at the goal prescribed for reward, he shall find himself in that position where the energies and talents possessed by him, matured by the rigorous discipline of his previous career, may be expanded and freely exercised for the benefit of his country.

February 11th.

Civil engineering and machinery generally.

By HENRY HENSMAN, Esq.

The ample field which the lecturer had undertaken to illustrate, necessitated him to give but a brief and imperfect summary of this the most attractive division of the Great Exhibition.

In remarking on the class most foolishly denominated by the Executive Committee as “machines for direct use,” the lecturer said, marine engines for driving the screw-propeller were objects

of much interest at the Exhibition; and rapid progress is making in this sort of engine, which offers in many cases great advantages for steam-vessels, even over the most improved form of direct-acting paddle-wheel engines. For, fortunately for the progress of science in this department, the long and firmly-established rules respecting the speed at which the pistons of condensing steam-engines should move were of necessity abandoned when the engines were connected direct on to the screw-shaft; and experience has proved that increased speeds in marine condensing engines may be obtained without any inconvenience, especially when canvass or India-rubber valves are substituted in the air-pumps for the old metal valves, which were quite unsuited for high speeds.

In reference to the weight of marine engines, he said, the old beam engines and flued boilers, with 3 or 4 lbs. steam, gave only a force equal to about that of two horses for each ton weight. The direct-acting engines and tubular boilers, and increased pressure and speed of piston, may be said to have brought each ton weight to equal the power of four horses, and, in one or two cases, even up to that of six horses. It must be borne in mind that owing to low pressure being used in marine engines, they are burdened with condensing apparatus, and are necessarily very bulky. Salt water, too, in many cases, and in all the necessity of guarding against fire on shipboard, prevents diminution in the boilers to the extent of those of locomotives; but, allowing for all these circumstances, it hardly justifies so great a difference in the power obtained from a certain weight in machinery as we find to exist between locomotive and marine engines. The Exhibition shewed us that in the better sorts of engines sent there the simplification of parts was very much studied, and especially in the screw-propeller engines, which, for condensing engines, are of great simplicity, compared with previous productions even of the same makers.

Of screw-propellers themselves, one great novelty was the feathering-screw, shewn by Messrs. Maudslay and Field, which allows the blades to be easily moved either into the proper position for propelling the vessel, or, when not steaming, they may be brought in a line with the stern-post, so as to offer little or no resistance to the progress of the vessel, if sailing.

Amongst the steam-engines was one sent by Mr. Davies, of Tipton, to which was attached a most beautifully-arranged governor. It consisted of a hollow ball with a zone round it, having an opening through the bottom to admit of an upright spindle, which was attached to the ball by a joint in its centre. One side of the ball and zone was made much heavier than the other; and consequently, when at rest or moving slowly, it hung down; but when driven fast, the centrifugal force of the heavy side overcame its gravity, and the zone assumed nearly a horizontal position. When this was the case, a small link inside the ball, jointed on one side of the axis, lowered the usual brass collar on the spindle, and shut off part of the steam, till the diminishing

speed allowed the gravity of the zone to overcome the centrifugal force, and then the link being raised, the throttle valve was opened wider and more steam admitted.

Included in the class with steam-engines were water-engines, acting by pressure from a water head, hydraulic presses, cranes, derricks, centrifugal and other pumps, blowing machines, fire-engines, locomotive engines, railway carriages, wheels and axles, and rails, chairs, turn-tables, and weighing-machines for railways: all these the lecturer briefly noticed.

In speaking of locomotives, he remarked that Hawthorn's engine was deserving of notice, as having been, some years ago, one of the first successful attempts to obtain dry steam from a low boiler, by means of a long steam-pipe running along inside the boiler near the top, and perforated with small holes or slits, which draw the steam off without taking the water as well. The arrangement of the springs also is peculiar; for, though a six-wheeled engine, yet the great weight is carried on bars, reaching from one axle to the other; and thus any wheel passing over an irregularity on the rails, only lifts each supporting spring half the amount due to this irregularity. This is also done in the Great Western engine, built by Sharp Brothers.

Crampton's engine, he said, differs from all others in having the axle of the driving-wheels placed behind the fire-box, which allows of a very low centre of gravity; and, when six wheels are used, the centre pair either has very light springs to serve as safety-wheels, in case either of the other axles break, or else the boiler is supported by one spring between the two axles. This has the effect of throwing the greater part of the weight upon the two end axles; and the centre of a cross-spring behind the fire-box carries the weight of this end of the boiler, so that it is very steady, from resting on three points. In his most modern arrangement with inside cylinders, the cranked axle has no wheels upon it; and being on the springs, is thus relieved of all strains from inequalities of the road: it is coupled to the driving-wheels by two rods, with outside cranks, and combines the straight axle of the driving-wheels with inside cylinders.

In the class of "Manufacturing Machines" (the most extensive in the whole Exhibition), the cotton machines were said to be the most remarkable, both for their extent and the very complete series they formed.

Here were to be found—especially in the admirable collection of machines by Messrs. Hibbert and Platt, of Oldham—machines adapted to display almost every process, from the opening of the cotton bales on their arrival in this country, up to the time of leaving the loom complete, in the state of calico ready for bleaching. The opportunity afforded to the general spectator of studying the immense number of complex operations required, was one that the world had never previously known, and the crowded state of the building in that part testified the interest it excited.

It is somewhat remarkable, that scarcely any cotton or other

machinery whatever was sent from Glasgow, or indeed from Scotland at all.

France and Belgium contributed some cotton machines, but none in actual operation; and therefore it is hardly safe or fair to institute a comparison of their powers of production; but, nevertheless, the "Depurator," or cotton-cleaner of M. Rialer, was thought deserving of a Council medal.

A highly-ingenuous cotton drawing-frame was sent from the United States by Mr. Hayden; and there was also exhibited, for the first time in this country, the saw-gin, for cleaning the seed cotton as it comes from the field, and separating it into the two parts—one the filaments of the cotton itself, as used in the manufactures—the remainder the comparatively valueless seed, which forms by far the largest part of the whole quantity grown.

A machine for printing calico on both sides was shewn by Mr. Dalton, and the accuracy with which the pattern on the two sides coincided was most wonderful; it was much to be regretted it was not worked, as it was almost the only cotton process—except bleaching—that was not shewn.

Woollen machinery was principally represented by one house,—that of Mason, of Rochdale; and a very complete and excellent set of machines were sent—some of them new, even to the trade, and especially to foreigners. The condenser-card, in particular, merits notice, from the rapidity and simplicity of its operation; and the award of a Council medal shews the estimate set by the Jury on its importance.

It is somewhat remarkable, that Leeds and the West Riding of Yorkshire should have sent plenty of woollen and worsted goods, but no machines whatever, with two exceptions;—one of them a very good set of worsted machines, by Mr. Berry, of Bradford; and the other the wool-combing-machine of Mr. Donisthorpe. This latter machine is one of the most effective ever produced: it is an automatic machine, performing the nice operation of separating the long wool from the short, and with such success, that uncombed wool put in at one side comes out at the other—the long completely sorted from the short, and much increased in value.

Among the French machinery, were some machines for carding and spinning wool, by Mercier and Co., to whom the Council medal was awarded: one part was particularly deserving of notice, viz., the arrangement of index wheels on the mule, for regulating at one operation the distance to which the thread shall be drawn out according to the fineness required, and also the amount of twist given to the thread.

The process of making card wire cloth was shewn by a most beautiful little machine sent by Mr. Crabtree, which, though not new in this country (the plan having been introduced some years since from America), yet to the public it was more attractive than almost any other in the Exhibition, and shewed in a most valuable manner how mechanical skill may produce machinery capable of performing the most delicate and difficult operations with unflinching regularity.

Flax machines were sent by Plummer of Newcastle, Messrs. Higgins of Manchester, and Lawson and Sons of Leeds. Mr. Plummer's breaking rollers, scutching mills, and heckling machines, shewed all the preparatory processes in the manufacture of hemp and flax, after being taken from the steeping pits; and Messrs. Lawson's machines shewed almost all the subsequent processes up to the complete formation of the flax into linen yarn, ready for the weaver, or for sewing purposes. The operation of drawing out and spinning flax usually requires the application of hot water to loosen the gum which holds the twisted fibres together, and this renders the air of the mills hot and unwholesome; but Lawsons's process, shewn in the Exhibition, dispenses with this hot process; for, by keeping the fibres less twisted at the time of drawing them out finer, cold water is found to be sufficient to dissolve enough of the gum to allow the individual fibres to slide one on the other, as much as is necessary: this has an important salutary influence on the health of the operatives employed.

The lecturer also referred briefly to some examples of rope machinery, looms for weaving sailcloth, canvass, brocaded silks, and fringe.

Circular hosiery machines and looms, exhibited from France, their parent country, as well as this country and Belgium, were, he said, a good example of the extent to which complexity of machinery may be profitably carried when its production is rendered more rapid. This was well shewn in the contrast between the simple stocking-frame and the more rapid production of the complex circular machine adjoining it; and still more the almost endless variety of parts and movements in the beautiful lace-machines sent from Nottingham, when contrasted with the former process in use only a few years since, when even plain lace net was made by the hand. The combination of the Jacquard apparatus to the previous complex machines has added much to their capability of making intricate patterns, and was well shewn by Mr. Birkin's machine, which was constantly worked. There is one point about the working of these machines that requires notice, which is, the constant breaking of threads that took place, especially early in the day; for these machines require a very dry warm room;—the least dampness of the atmosphere causing the threads to break. The same is the case with the threads in the cotton-spinning mills.

Printing-presses and machines, shewn by English exhibitors, were numerous and very good; but few, if any, were on the foreign side. The hand-presses had amongst them two or three examples of self-inking apparatus, which is a step towards reducing the time necessary for each impression,—and probably, for small presses, they will succeed; but objections are made that in a press of any great size the labor is too heavy for the pressman.

The largest and most novel printing-machine shewn in the Exhibition was the vertical machine invented by Mr. Applegath for newspaper printing, and which was fixed and worked in a

most spirited manner by Mr. Ingram, the proprietor,—the whole time printing the “*Illustrated News*.”

Towards the close of the Exhibition a newspaper-folding machine was got to work by Mr. Lovesey; and the public had the satisfaction of seeing this final operation performed for the first time in the building. A smaller folding machine had been shewn previously in operation for book-work, by Mr. Black, of Edinburgh, to whom the credit of introducing the plan is due.

Paper machinery was shewn in model by Fourdrinier’s first machine, and a model of a modern machine by Donkin; but it was only in the French machinery that a full-sized machine was exhibited.

In speaking of Civil Engineering and Architecture, the lecturer said that among the few contributions to this class, were two models of remarkable and successful boldness of design,—Stephenson’s tubular bridge over the Menai Straits, and Brunel’s iron truss bridge over the Wye, at Chepstow. The beauty of the workmanship in the first-named model, which was executed by Mr. James, is something quite unprecedented; for all the parts are made to scale in the most minute particulars. The suspension bridge, by Mr. Vignoles, over the Dnieper, at Kieff, in Russia, was represented by another model by James—equal, if not superior, in workmanship to the other. Mr. Leather sent some very good models of his bridges, made by Salter; and a good model of Stephenson’s double high-level bridge, at Newcastle, was sent by Hawkes & Co. Some railway drawbridges were contributed from Holland, and are excellent of their kind; as also a large model of a suspension truss-bridge, from the United States, by Mr. Rider.

In conclusion, the lecturer said, that in reviewing thus rapidly the immense quantity of machinery and models brought before us at the Exhibition, it is quite evident that many valuable contributions have been unnoticed; but the object of these lectures is not so much a description of what was there, as of the probable influence that the Exhibition will have upon the future state of things. Very many forcible contrasts have been drawn between rival exhibitors, both by themselves and others interested; and there are few, if any, even of the most advanced class, that have not found themselves outstripped in some point or other, and learned lessons that will shew early results. The impulse given to machine-making in every branch is very great; and it will have been found that though in this country, from our numerous mechanical publications, we are tolerably well acquainted with one another’s engineering doings, yet it is a very different affair as to our knowledge of what other nations are about. This may be seen in the reaping-machines, now first heard of; in the upsetting all previous notions of the security of our locks; in the lessons taught us as to the hulls and sails of our vessels; and in the superiority evinced in the manufacture of steel rollers from Prussia: none of which were known to us previously, except in a very vague manner.

List of Patents

Granted for SCOTLAND, from the 22nd February to the 22nd March, 1852.

- To William Hamer, of Manchester, for certain improvements in looms for weaving.—Sealed 23rd February.
- Peter Armand Le Comte de Fontainemoreau, of 4, South-street, Finsbury, London, for certain improvements in gas-burners,—being a communication.—Sealed 26th February.
- Charles John Mare, of Blackwall, for improvements in constructing iron ships or vessels, and steam-boilers.—Sealed 1st March.
- Henry Glynn, of Bruton-street, Berkeley-square, London, and Rudolph Appel, of Gerrard-street, Soho, anastatic printer, for improvements in the manufacture or treatment of paper or fabrics, to prevent copies or impressions being taken of any writing or printing thereon.—Sealed 1st March.
- William Edward Newton, of the Office for Patents, 66, Chancery-lane, London, civil engineer, for improvements in the heddles or harness of looms for weaving, and in the machinery for producing the same,—being a communication.—Sealed 2nd March.
- Henry Bessemer, of Baxter House, Old St. Pancras-road, London, for improvements in expressing saccharine fluids, and in the manufacture, refining, and treating sugar.—Sealed 3rd March.
- Frederick Crace Calvert, of Manchester, Professor of Chemistry, for improvements in manufacturing iron, and in manufacturing and purifying coke.—Sealed 4th March.
- John Henry Johnson, of 47, Lincoln's-inn-fields, London, and of Glasgow, for improvements in weaving carpets and other fabrics, and in the machinery or apparatus employed therein,—being a communication.—Sealed 4th March.
- William Sinclair, of Manchester, engineer, for certain improvements in locks.—Sealed 8th March.
- John Blair, of Irvine, Ayrshire, for certain improvements in beds or couches, and other articles of furniture.—Sealed 10th March.
- Perry G. Gardiner, of the City of New York, United States, civil engineer, for improvements in the manufacture of malleable metals into pipes, hollow shafts, railway-wheels, or other analogous forms, which are capable of being dressed, turned down, or polished in a lathe.—Sealed 10th March.
- Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, London, mechanical draughtsman, for improvements in machinery for combing wool and other fibrous substances,—being a communication.—Sealed 15th March.
- Alexander Cuninghame, of Glasgow, iron-master, for improvements in the treatment and application of slag, or the refuse matter of blast-furnaces.—Sealed 15th March.
- William Charles Scott, of Camberwell, Surrey, for certain im-

- provements in the construction of omnibuses, and other public and private carriages.—Sealed 15th March.
- William Stirling Lacon, of Great Yarmouth, county of Norfolk, Gent., for improvements in the means of suspending ships' boats and of lowering the same into the water.—Sealed 16th March.
- John Mercer, of Oakenshaw, Clayton-le-Moors, chemist, and John Greenwood, of Irwell Springs, Bacup, Turkey-red dyer, for certain improvements in preparing cotton and other fabrics for dyeing and printing.—Sealed 17th March.
- Charles Middleton Kernot, of West Cowes, in the Isle of Wight, and William Hirst, of Manchester, manufacturer, for certain improvements in the manufacture of woollen cloth, and cloth made from wool and other materials; and in machinery or apparatus for manufacturing the same.—Sealed 17th March.
- William Pidding, of the Strand, London, for improvements in mining operations, and the machinery or apparatus connected therewith.—Sealed 22nd March.
- James Joseph Brunet, of the Canal Iron Works, Poplar, engineer, for certain improved combinations of materials in ship building,—being a communication.—Sealed 22nd March.
- Emmanuel Charles Theodore Croutelle, of Rheims, France, manufacturer, for certain improvements in machinery or apparatus for preparing woollen threads, and other filamentous substances, for weaving.—Sealed 22nd March.
- Charles Barlow, of 89, Chancery-lane, London, for improvements in rotatory engines,—being a communication.—Sealed 22nd Mar.
- William Lymington, of Trafalgar-place, West Hackney-road, London, Charles Finlayson, of Manchester, engineer, and John Reed, of the same place, for improvements in flues, and in heating air; and in evaporating certain liquids by heated air.—Sealed 22nd March.
- Edward Moseley Perkins, of Mark-lane, London, for improvements in the manufacture of cast metal pipes, retorts, or other hollow castings.—Sealed 22nd March.
- John Wallace Duncan, of Grove-end-road, St. John's Wood, London, for improvements in engines for applying the power of steam, or other fluids, for impelling purposes; and in the manufacture of appliances for transmitting motion.—Sealed 22nd March.

New Patents

SEALED IN ENGLAND.

1852.

To John Elce, of Manchester, in the county of Lancaster, machinist, and John Bond, of Burnley, in the said county, machinist, for certain improvements in machinery for preparing cotton and other fibrous substances; also in machinery or apparatus

- applicable to looms for weaving; and the tools employed therein. Sealed 26th February—6 months for inrolment.
- Charles Reeves, jun., of Birmingham, manufacturer, for certain improvements in the manufacture of bayonets, swords, and other cutting instruments. Sealed 27th February—6 months for inrolment.
- Charles John Mare, of Blackwall, in the county of Middlesex, for improvements in constructing iron ships or vessels and steam-boilers. Sealed 27th February—6 months for inrolment.
- James Pilbrow, of Tottenham, in the county of Middlesex, civil engineer, for certain improvements in apparatus for supplying the inhabitants of towns and other places with water. Sealed 3rd March—6 months for inrolment.
- George Leopold Ludwig Kufahl, of Christopher-street, Finsbury, London, engineer, for improvements in fire-arms. Sealed 3rd March—6 months for inrolment.
- George Wilkinson, of Streatham-terrace, Shadwell, engineer, for improvements in ships and other pumps. Sealed 4th March—6 months for inrolment.
- Alfred Trueman, of Swansea, manager of copper smelting works, and John Cameron, of Loughor, chemist, for improvements in obtaining copper ores. Sealed 4th March—6 months for inrolment.
- Alexander Parkes, of Birmingham, for improvements in separating silver from other metals. Sealed 8th March—6 months for inrolment.
- Edward Moseley Perkins, of Mark-lane, in the City of London, for improvements in the manufacture of cast metal pipes, re-torts, or other hollow castings. Sealed 8th March—6 months for inrolment.
- James Graham, of Camden-grove, Peckham, in the county of Surrey, for improvements in treating ores containing zinc, and the products obtained therefrom. Sealed 8th March—6 months for inrolment.
- James Wanbrough, of Albert-road, Mile End, manufacturer, and William Allen Turner, of Fish-street Hill, in the City of London, merchant, for improvements in the manufacture of flocked fabrics. Sealed 8th March—6 months for inrolment.
- Frederick George Underhay, of Wells-street, Gray's-inn-road, engineer, for improvements in apparatus for regulating the supply of water to water-closets and other vessels; and in taps or cocks for drawing off liquids. Sealed 8th March—6 months for inrolment.
- Enrico Angelo Ludovico Negretti, and Joseph Warren Zambra, both of Hatton-garden, in the City of London, meteorological instrument makers, for improvements in thermometers, barometers, gauges, and other instruments for ascertaining and registering the temperature pressure, density, and specific gravity, of aeriform fluids and liquid or solid bodies. Sealed 8th March—6 months for inrolment.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in machinery for combing wool and other fibrous substances,—being a communication. Sealed 8th March—6 months for enrolment.

George Wright, of Sheffield, and also of Rotherham, in the county of York, artist, for improvements in stoves, grates, or fire-places. Sealed 8th March—6 months for enrolment.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in propelling vessels,—being a communication. Sealed 8th March—6 months for enrolment.

Joshua Crockford, of Southampton-place, in the county of Middlesex, Gent., for improvements in brewing, and in brewing apparatus. Sealed 8th March—6 months for enrolment.

Augustus Turk Forder, of Leamington Priors, in the county of Warwick, solicitor, for an improved fender. Sealed 8th March—6 months for enrolment.

Richard Archibald Brooman, of the firm of J. C. Robertson and Co., of Fleet-street, in the City of London, for improvements in presses, and in pressing,—being a communication. Sealed 8th March—6 months for enrolment.

Charles Augustus Preller, of Abchurch-lane, in the City of London, merchant, for improvements in the preparation and preservation of skins and animal and vegetable substances,—being a communication. Sealed 8th March—6 months for enrolment.

Uriah Scott, of Grove-street, Camden-town, in the county of Middlesex, engineer, for improvements in wheels; and in springs and spring-bearings for carriages. Sealed 8th March—6 months for enrolment.

John Henry Johnson, of 47, Lincoln's-inn-fields, in the county of Middlesex, and of Glasgow, North Britain, for improvements in weaving carpets and other fabrics; and in the machinery or apparatus employed therein,—being a communication. Sealed 8th March—6 months for enrolment.

Walter Young, of Springfield Iron Works, Salford, in the county of Lancaster, millwright and engineer, for an improvement or improvements in steam-engines. Sealed 8th March—6 months for enrolment.

Alexander Cuninghame, of Glasgow, in the county of Lanark, North Britain, iron-master, for improvements in the treatment and application of slag, or the refuse matter of blast furnaces. Sealed 8th March—6 months for enrolment.

William Pidding, of the Strand, in the county of Middlesex, Gent., for improvements in mining operations; and in the machinery or apparatus connected therewith. Sealed 8th March—6 months for enrolment.

Peter Van Kempen, of West Ham, in the county of Essex, accountant, for an improved refrigerator, to be used in brewing,

- distilling, and other similar useful purposes,—being a communication. Sealed 8th March—6 months for enrolment.
- William Willcocks Sleigh, physician and surgeon, of London, for a counteracting reaction motive power engine. Sealed 8th March—6 months for enrolment.
- Alexander Hédiard, of Rue Taitbout, Paris, France, [Gent., for certain improvements in rotary steam-engines. Sealed 8th March—6 months for enrolment.
- Paul Rapsey Hodge, civil and mechanical engineer, of 9, Adam-street, Adelphi, in the county of Middlesex, for certain improvements in the construction of railways and railway carriages; parts of which are applicable to carriages on common rails,—being a communication. Sealed 8th March—6 months for enrolment.
- Thomas Ellison, of No. 6, Queen's-road, Pentonville, in the county of Middlesex, painter, plumber, and glazier, for certain improvements in the manufacture of imitation marbles, granites, and all sorts of stones. Sealed 8th March—6 months for enrolment.
- Pierre Henri Bureau, of Paris, in the Republic of France, manufacturer, for certain improvements in the manufacture of carpets, velvets, and other fabrics. Sealed 8th March—6 months for enrolment.
- William Smith, of 90, Park-street, Grosvenor-square, civil engineer, and Archibald Smith, of Princes-street, Leicester-square, engineer and machinist, for certain improvements in electric and electro-magnetic telegraph apparatus; and in the machinery for and method of making and laying down submarine, submerged, and other such lines. Sealed 8th March—6 months for enrolment.
- Joseph Denton, of Rochdale, Lancaster, Gent., for improvements in machinery or apparatus for manufacturing looped, terry, or other similar fabrics. [N.B.—This patent being opposed at the Great Seal, was not sealed till the 8th March, but bears date the 23rd of February last, the day it would have been sealed had no opposition been entered.]
- Colin Mather, of Salford, in the county of Lancaster, machine-maker, and Ernest Rolffs, of Cologne, in the Kingdom of Prussia, Gent., for certain improvements in printing, damping, stiffening, opening, and spreading woven fabrics. Sealed 11th March—6 months for enrolment.
- Benjamin Goodfellow, of Hyde, in the county of Chester, engineer, for improvements in boilers for generating steam. Sealed 11th March—6 months for enrolment.
- John Mercer, of Oakenshaw, Clayton-le-moors, chemist, and John Greenwood, of Irwell Springs, Bacup, Turkey-red dyer, both in the county of Lancaster, for certain improvements in preparing cotton and other fabrics for dyeing and printing. Sealed 15th March—6 months for enrolment.

Francis Wheatley, of Greenwich, Gent., for an improved safety-cab omnibus. Sealed 18th March—6 months for inrolment.

William Froggott, of Manchester, house and decorative painter, for a certain improvement or improvements in the process of decorative painting; which improvement or improvements are applicable to rooms, halls, carriages, furniture, and other purposes to which decorative painting has or may be applied. Sealed 20th March—6 months for inrolment.

John M'Dowall, of Walkinshaw Foundry, Johnstone, in the county of Renfrew, N.B., engineer, for improvements in cutting wood and other substances, and in the machinery or apparatus employed therein, and in the application of power to the same; parts of which improvements are applicable for the transmission of power generally. Sealed 20th March—6 months for inrolment.

William Westley Richards, of Birmingham, gun manufacturer, for certain improvements in fire-arms, and in the means used for discharging the same; also improvements in projectiles. Sealed 20th March—6 months for inrolment.

William Symington, of Trafalgar-place West, Hackney Road, in the county of Middlesex, Gent., Charles Finlayson, of Manchester, engineer, and John Reid, of the same place, Gent., for improvements in flues, and in heating air, and in evaporating certain fluids by heated air. Sealed 22nd March—6 months for inrolment.

John Drumgoole Brady, of Cambridge Terrace, in the county of Middlesex, Esq., for improvements in helmets, cartridge-boxes, and other military accoutrements. Sealed 22nd March—6 months for inrolment.

Edmund Morewood and George Rogers, both of Enfield, in the county of Middlesex, Gent., for improvements in shaping, coating, and applying sheet metal to building purposes. Sealed 24th March—6 months for inrolment.

John Mackintosh, of Berners-street, in the county of Middlesex, civil engineer, for improvements in ordnance and fire-arms, and in balls and shells. Sealed 24th March—6 months for inrolment.

Antoine Maurice Tardy de Montravel, of Paris, in the Republic of France, Gent., for certain improvements in obtaining motive power, and the machinery employed therein. Sealed 24th March—6 months for inrolment.

Isaac Brooks, of Birmingham, in the county of Warwick, manufacturer, and William Lutwyche Jones, of Birmingham, aforesaid, manufacturer, for certain improvements in stoves, and other apparatus for heating. Sealed 24th March—6 months for inrolment.

William Whittaker Collins, of Buckingham-street, Adelphi, civil engineer, for certain improvements in the manufacture of steel. Sealed 24th March—6 months for inrolment.

William Cole, of Birkenhead, in the county of Chester, architect, and Alfred Holt, of Liverpool, in the county of Lancaster, civil engineer, for an improved method of preventing and removing the deposit of sand, mud, or silt, in tidal rivers, in certain cases, and also in harbours, docks, basins, guts, or other channels communicating with the sea through tidal rivers, or otherwise; the same being applicable, in certain cases, to other rivers or moving waters. Sealed 24th March—6 months for enrolment.

John White and Robert White, of Cowes, in the Isle of Wight, ship-builders, for improvements in ship-building. Sealed 24th March—6 months for enrolment.

William Henry Hulseberg, of Mile-End, in the county of Middlesex, for certain improvements in the treatment of wool, hair, feathers, fur, and other fibrous substances, and in machinery or apparatus for the same,—being a communication. Sealed 24th March—6 months for enrolment.

William Archer, of Hampton Court, in the county of Middlesex, Gent., for an improved mode or modes of preventing accidents on railways. Sealed 24th March—6 months for enrolment.

Thomas Bell, of Don Alkali Works, South Shields, for improvements in the manufacture of sulphuric acid. Sealed 24th March—6 months for enrolment.

Richard Parris, of Long Acre, in the county of Middlesex, modeller, for improvements in machinery or apparatus for cutting and shaping cork. Sealed 24th March—6 months for enrolment.

William Pidding, of the Strand, Gent., for improvements in the construction of vehicles used on railways or on ordinary roads. Sealed 24th March—6 months for enrolment.

Edward Hammond Bentall, of Heybridge, in the county of Essex, iron-founder, for improvements in the construction of ploughs. Sealed 25th March—6 months for enrolment.

John Smith, of Bilston, in the county of Stafford, brass-founder, for certain improvements in locomotive and other steam-engines. Sealed 25th March—6 months for enrolment.

William Thompson, of Salford, in the county of Lancaster, machine-maker, and John Hewitt, of Salford aforesaid, machine-maker, for improvements in machinery for spinning, doubling, and twisting cotton, and other fibrous substances. Sealed 27th March—6 months for enrolment.

Jean Jacques Bourcart, of the firm of Nicholas Schlumberger and Co., of Guébillier, in France, for improvements in preparing, combing, and spinning wool, and other fibrous materials,—being a communication. Sealed 27th March—6 months for enrolment.

CELESTIAL PHENOMENA FOR APRIL, 1852.

D. H. M.		D. H. M.	
1	Clock before the ☉ 3m. 51s.	14	Venus pass mer. 2h. 52m.
—	☿ rises 2h. 16m. A.	—	Mars pass mer. 6h. 51m.
—	☿ pass mer. 9h. 48m. A.	—	Jupiter pass mer. 13h. 42m.
—	☿ sets 4h. 36m. M.	—	Saturn pass mer. 0h. 45m.
3 23	☿ in Perigee	—	Uranus pass mer. 0h. 35m.
4	Ocul. 80, Virginis, im. 12h. 32m. em. 13h. 32m.	4 2	☿'s third sat. will im.
2 24	Ecliptic oppo. or ☉ full moon	15	Clock after the ☉ 0m. 4s.
22 38	☿ in conj. with ♄ diff. of dec. 2. 47. N.	—	☿ rises 4h. 19m. M.
5	Clock before the ☉ 2m. 39s.	—	☿ pass mer. 9h. 21m. M.
—	☿ rises 8h. 2m. A.	—	☿ sets 2h. 33m. A.
—	☿ pass mer. 0h. 33m.	9 24	☿'s first sat. will im.
—	☿ sets 6h. 15m. M.	17 1 53	☿'s second sat. will im.
6 1 0	☿ in Perihelion	10 0	☿ in Apogee
11 43	☿ in conj. with the ☿ diff. of dec. 2. 44. S.	19 5 57	♄ in conj. with the ☿ diff. of dec. 4. 27. N.
15 33	☿ in conj. with ♄ diff. of dec. 4. 52. N.	7 56	☿ stationary
7 0 3	☿'s third sat. will im.	11 46	Ecliptic conj. or ☉ new moon
1 2	☿'s first sat. will im.	12 4	♄ in conj. with the ☿ diff. of dec. 2. 31. N.
8 9 46	☿ greatest hel. lat. N.	20	Clock after the ☉ 1m. 13s.
9	Ocul. B.A.C., 6343, im. 17h. 17m. em. 18h. 22m.	—	☿ rises 5h. 47m. M.
7 26	☿ greatest elong. 19. 22. E.	—	☿ pass mer. 0h. 49m. A.
11 19	☿'s second sat. will im.	—	☿ sets 8h. 4m. A.
10	Clock before the ☉ 1m. 14s.	38	☿ in conj. with the ☿ diff. of dec. 7. 19. N.
—	☿ rises 1h. 16m. M.	21 4 46	☿'s first sat. will im.
—	☿ pass mer. 5h. 14m. M.	22 11 18	☿'s first sat. will im.
—	☿ sets 9h. 11m. M.	22 40	☿ in conj. with the ☿ diff. of dec. 4. 47. N.
11 8 59	☿ in ☐ or last quarter	23	Ocul. π in Tauri, im. 9h. 50m. em. 10h. 43m.
14	Mercury, R. A., 2h. 38m. dec. 18. 35. N.	23 22	♄ in conj. with the ☉
—	Venus, R. A., 4h. 23m. dec. 24. 15. N.	24 4 27	☿'s second sat. will im.
—	Mars, R. A., 8h. 22m. dec. 21. 52. N.	25	Clock after the ☉ 2m. 11s.
—	Vesta, R. A., 0h. 10m. dec. 4. 9. S.	—	☿ rises 8h. 28m. M.
—	Juno, R. A., 22h. 15m. dec. 4. 10. S.	—	☿ pass mer. 4h. 53m. A.
—	Pallas, R. A., 5h. 6m. dec. 4. 17. S.	—	☿ sets 0h. 24m. M.
—	Ceres, R. A., 6h. 55m. dec. 30. 11. N.	26 21 5	♄ in conj. with the ☿ diff. of dec. 0. 17. S.
—	Jupiter, R. A., 15h. 16m. dec. 16. 51. S.	27 3 10	♄ in conj. with the ☉
—	Saturn, R. A., 2h. 16m. dec. 11. 24. N.	8 3	☿ in ☐ or first quarter
—	Uranus, R. A., 2h. 6m. dec. 12. 22. N.	23 52	♄ in ☐ with the ☉
—	Mercury pass mer. 1h. 6m.	28 10 17	☿ greatest hel. lat. N.
		29 15 36	☿ in inf. conj. with the ☉
		30	Clock after the ☉ 2m. 57s.
		—	☿ rises 2h. 36m. A.
		—	☿ passes mer. 9h. 23m. A.
		—	☿ sets 3h. 31m. M.
		1 12	☿'s first sat. will im.
		58	☿ in conj. with Pallas, diff. of dec. 28. 28. S.

J. LEWTHWAITE, Rotherhithe.

THE
LONDON JOURNAL,
AND
REPERTORY
OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXLV.

RECENT PATENTS.

To DANIEL ILLINGWORTH, of Bradford, in the county of York, worsted spinner, for certain improvements in machinery for preparing all descriptions of wool and hair grown upon animals, for the carding, combing, and other manufacturing processes.—[Sealed 22nd August, 1850.]

THESE improvements relate to the machinery employed in the preparation of those wools or hairs of animals which are intended either to be subjected to a subsequent process of combing, as in the "worsted" manufacture, or to those operations by which such materials are fitted for the production of "woollens," or for other purposes.

The first part of the invention includes two distinct machines, the one more particularly applicable to the preparation of short fibrous substances, and the other suitable for operating upon all descriptions of the material,—the object, however, of both being to open and cleanse the locks (at the same time preserving the fibre) in a more efficient manner than is now performed by the ordinary willow.

The second part of the invention relates to the carding-engine, and consists in the employment of a pair of rollers in front of the ordinary feed-rollers, but revolving rather slower, whereby the material is, in some measure, straightened before it enters the machine.

A longitudinal vertical section of the machine for preparing short fibrous substances is represented at fig. 1, in Plate X. *a*, is the frame-work. *b*, is the main driving-shaft, provided with a pinion *f*, which, through the medium of a train of wheels and pinions, communicates rotary motion to one of two rollers *g*, *g*, that carry an endless feed-apron *h*, *h*.

Two rollers *i*, are mounted in slots, formed within standards, attached to the framing; the upper roller is weighted upon the other by means of levers and weights; and they are driven through the intervention of the train of pinions actuated by the shaft *b*. Immediately in front of the rollers *i*, are three other rollers *j, j, j*,—the upper one being pressed upon the surfaces of the two lower ones by means of weighted levers *k*. The surfaces of the three rollers revolve at a uniform rate; and the train of wheels, whereby they are driven, is so calculated as to cause the velocity of their peripheries to exceed that of the peripheries of the rollers *i*, so as to effect a drawing action. In front of the rollers *j, j*, is placed a revolving fan or beater, consisting of a cylinder of metal, or other suitable material, *c*, upon which are mounted the beaters *l, l*. The fan or beater is enclosed at top by a cylindrical casing *d*, and partly at its lower portion by a grating *m*; and it is mounted upon a shaft *e*, which is caused to rotate by means of a strap, passing from a pulley affixed to the shaft *b*. Upon the axle of the fan or beater there is a pulley, which communicates motion, by a strap, to the shaft *n*, of another fan, consisting of broad vanes *o, o*, and enclosed within a concentric case; and, beyond this, there is an air-tight casing *p*, having its bottom formed as a grating *p**, the apertures of which communicate with a box for the reception of dust or other impurities. Within a box, attached to the framing *a**, are placed two cylinders *q, q*, formed of perforated metal, or other suitable material, or of wire gauze, and mounted upon axles, which receive a slow rotatory motion from the main shaft *b*. Beneath the cylinders *q, q*, is placed an exhausting fan *r*, around which there is a casing *s, s*; such casing, however, does not extend the whole width of the machine; and it is provided with an opening *s**, at each side, communicating with a passage, formed at either end of the fixed board *z*.

The operation of the machine is as follows:—The wool, having been sorted in the usual manner, is placed evenly upon the feed-apron *h*, which, as it revolves, conveys the material to the rollers *i*, whence it is passed on to the drawing-rollers *j*. By the action of these rollers it is partially pulled apart and straightened, so that it may be more easily operated upon by the fan or beater *c, l*; and this beater, as it rapidly revolves, opens the entangled locks, and, beating them downwards upon the grating *m*, separates much of the dirt or other extraneous matter, which falls through the open spaces into a box below. The material is next operated upon

by the fan *o*, which, by its rapid revolutions, still further opens the entangled locks, and drives them upwards towards the inclined grating *p**. The exhausting apparatus *r*, by withdrawing the air from the casing *p*, now causes the opened wool to fly onwards, and accumulate upon the peripheries of the perforated cylinders *q*, *q*,—the dirt and other impurities falling through the grating *p**, into a box below. As the cylinders revolve, they carry forward the opened material,—any dirt or loose impurities, still in combination therewith, being drawn through the perforations, and discharged with the air through the apertures *s**; and the cleaned wool falls down the inclined board *t*, ready for the subsequent ordinary operations. For the purpose of preventing the wool from being drawn by the exhaustion of air, so as to obstruct its delivery from the cylinders *q*, there are applied blocks *y*, *y*, attached to bosses, which are mounted loosely upon the cylinder-shafts, and, extending through the side-casing, are affixed to the frame-work of the machine. The patentee remarks that, if desired, only one cylinder *q*, may be employed; and also that other modifications of arrangement may be made.

The second improved machine is shewn, in plan view, at fig. 2, and in side elevation at fig. 3. The frame-work *a*, supports, at one end, the main driving-shaft *b*, carrying a pulley *c*, which, by means of a strap, communicates rotary motion to a cross-shaft *d*. On this shaft there are four cranks *e*, connected by rods *f*, to levers *g*, capable of vibrating upon centres *h*. Each lever *g*, carries a small roller *i*, provided with a socket, in which is secured a beater *j*; and to each roller *i*, two straps *k*, are attached,—such straps being wound upon the roller in reverse directions, and secured at their other ends, and at opposite sides of the roller *i*, to the frame-work of the machine. To the cranks *e*, are also connected other rods *f**, levers *g**, rollers *i**, and beaters *j**;—the arrangement being precisely the same as at the other end of the machine. At each side of the frame-work is mounted a fluted roller *l*, the grooves whereof receive a series of endless cords *m*, which also pass under guide-rollers *n*; and such cords constitute a flexible and open table, upon which the wool is to be beaten by the rods or beaters *j*. To the axle of one of the rollers *l*, is affixed a pinion *o*, gearing with another pinion *p*, mounted upon an upright shaft *q*; the lower end of which shaft is provided with a pinion, taking into the teeth of another pinion, mounted upon a horizontal shaft *r*; and this shaft also carries a worm-wheel, in gear with a worm affixed

to the shaft *d*: by which arrangement the roller *l*, is caused to revolve and carry round the series of endless strings *m*. In order to gain a support for the strings *m*, and to keep them asunder, so as to form a regular grating, there are cross-pieces *s*, upon which they rest,—such pieces being formed with a corresponding number of grooves to serve as guides.

In the following description of the action of this machine, the various movements of one of the beaters *j*, are first explained separately, in order that the action of the series may be more readily understood.

Fig. 4, is a detached view of one of the beaters and its immediate appurtenances. Suppose the parts to be in the position represented by the fine dotted lines,—the shaft *d*, being, by the before-mentioned means, caused to revolve in the direction of the arrow, will, through the intervention of the crank *e*, and connecting-rod *f*, cause the lever *g*, to turn upon its centre of motion *h*,—thereby carrying with it the roller *i*, and drawing forward the beater *j*, until the strap *k*, shall have become distended: which position of the parts is represented by the full or unbroken lines. A further revolution of the crank, and consequent vibration of the lever *g*, will cause the now tightened strap *k*, to effect a sudden rotation of the roller *i*; and, by this means, the beater will be thrown over and brought into the position represented by the thick dotted lines. The crank *e*, still revolving, will now draw back the beater in a nearly horizontal direction, until the strap *k*¹, in its turn, shall have become distended; when, by similar means to those already described, the beater *j*, will be turned over to its original position; and so on for each revolution of the shaft. In fig. 3, four cranks are shewn, applied to the shaft *d*, at different parts of the circle of rotation; and to each are connected two beaters and their appendages, acting on opposite sides of the machine,—by which disposition a rapid succession of blows is obtained; but, if desired, there may be a less or greater number of beaters employed. The machine being put in motion, by any suitable driving power, the fibrous substance to be opened and cleaned is placed upon the endless cords *m*;—these being kept in motion, by the means before described, carry the material slowly forward, so as to bring it under the successive action of the beaters *j*; which, as they alternately descend, open, by their batting operation, the entangled locks, and cause the dirt and other impurities to fall between the cord grating *m*, into a box below; and the opened and cleaned

material is delivered at the opposite side of the machine, ready for the ordinary subsequent operations. In order to prevent a sudden concussion, upon the return of the beaters *j*, to their starting position, a stuffed bag, or other partially elastic substance, *y*, is applied at each extremity of the machine; and for the purpose of preventing the wool from being drawn off the endless travelling cords, side-boards *w*, are attached to the frame-work,—such boards having slots formed therein, in order to admit of the descent of the beaters *j*. The beaters *j*, are to be formed of bullock's pizzle, or other such animal substance, and attached to the rollers *i*, by inserting them in sockets, or by other convenient means: they may, however, be constructed of wood, or other suitable materials.

The improvement in carding-engines is shewn in the partial sectional view, fig. 5. *a, a*, are the ordinary feed-rollers, and *b, b*, are the additional rollers, placed in front, and caused to revolve at a rate somewhat slower than the rollers *a, a*: by which arrangement the material is held back from the feed, so as to be pulled out and partially straightened before it is received by the carding-engine.

The patentee claims, Firstly, as applied to the preparation of wool and other hairs of animals,—the use of the revolving fan or beater *c, l*; also the general combination and construction of machinery, shewn at fig. 1. Secondly,—the employment of an instrument, or series of instruments, actuated by a revolving shaft or shafts, so as to effect a beating action upon the material as it passes through the machine; also constructing the beaters, used for the purpose above set forth, of bullock's pizzle, or other such animal substance. Thirdly,—the employment of the rollers *b, b*, described with reference to fig. 5.—[Inrolled February, 1851.]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in machinery for carding cotton, wool, or other fibrous materials, and in apparatus for preparing or setting the cards of carding-engines,—being a communication.—[Sealed 11th June, 1850.]

THIS invention relates to the preparation of drums, cylinders, or rollers, for the reception of wire cards; and also to the production of rollers suitable for setting or grinding such wire cards; and it consists in providing them with a covering of sheet paper, upon which, in the one case, the cards, either in sheet

or in fillet, may be attached, and, in the other case, a coating of emery or other such material may be applied.

The drums, cylinders, or rollers, to be prepared, may be constructed in any manner now usually practised, as far as relates to the framework thereof, and may be covered with sheet-iron, as is well understood; or they may be of cast-iron, if desired. If the former of these constructions be adopted, there will probably exist a certain degree of inequality in the periphery of the cylinder, drum, or roller; and this inequality is first to be removed,—which may, in a great measure, be accomplished by hammering or otherwise equalizing the surface; but, in order to gain a perfectly cylindrical periphery, it will be found convenient to adopt the following method:—A layer of oil paint is laid upon the sheet-iron, and a quantity of fine sand sprinkled thereon; and when this has become dry, a mixture, formed of heated glue and sand (of a consistence capable of being used with a trowel), is spread upon the surface to be prepared; and the drum, cylinder, or roller, is placed in a lathe, for the purpose of scraping or turning off the superabundant sand and glue: by which operation the inequalities will have become filled up, and a sufficiently true cylindrical surface obtained. In using the above mixture, care should be taken to sift the sand, and to cause it to be perfectly mixed with the glue, so as to obtain a homogeneous compound. It will also be necessary to turn or scrape off the composition before it becomes perfectly dry or hard; and this should be done by a slow motion of the lathe, as otherwise the layer may be wholly or in part thrown off. The mixture of glue and sand having been allowed to dry, a layer of paper, which has been covered with a composition of glue and gum-arabic (the latter in the proportion of about ten per cent.) is to be placed thereon; and after this is perfectly dry, another layer is in like manner to be applied; and so on until a sufficient thickness has been obtained. After which, a coating of glue is to be spread evenly over the surface, and then sprinkled with fine sifted sand; and when this is dry, a paste, similar to that before described, is to be prepared and spread upon the periphery of the cylinder or roller, which is to be again placed in the lathe and the surface rendered true, as before directed. If the inequalities be considerable, this operation may be repeated,—care being taken to allow the paste to dry between each application. The cylinder, drum, or roller (if perfectly dry), will now be ready to receive the finishing part of its preparation. For this purpose, a sheet of paper is to be laid accurately over its surface with cold starch; and when this is

dry, two coats of varnish are to be applied: the operation will then be complete.

When cylinders or rollers of cast-iron are employed, the application of the paste for the purpose of gaining a cylindrical surface may be dispensed with, if desired, by turning the metal in a lathe, so as to get the required truth: the finishing by means of the pasty mixture will, however, still be applicable.

In order to attach sheets of cards to the cylinders or rollers, prepared as described, nails may be used; as in the ordinary manner,—the layers of paper being laid on to a thickness sufficient for the length of nail employed. In cases where fillets are used, a thick sheet of paper only may, if desired, be applied, and the fillets attached, by means of screws, to the rings or other parts of the cylinder, &c., or by nails; for the reception of which a plug of wood is provided, as ordinarily practised.

In order to prepare rollers for the reception of emery, or other such grinding substance, the process already described is to be followed,—excepting that it is preferred to use paint instead of varnish for finishing the surface, upon which the emery is to be applied in the usual manner.

The patentee remarks, in conclusion, that he does not claim the covering of cylinders or rollers with papier-maché, or paper pulp, as he is aware that something of this kind has been heretofore done.

He claims, First,—the covering of cylinders, drums, or rollers, employed in the operation of carding, with a layer or layers of paper, for the purpose above set forth. Secondly,—the covering of rollers, used for grinding or setting the cards of carding machines, with a layer or layers of paper, upon which emery or other such substance may be applied; also, the combination of operations, above described, for obtaining a suitable cylindrical surface on the cylinders, drums, or rollers of carding-engines, and for the rollers employed in setting or grinding wire cards.—[Inrolled December, 1850.]

To JOHN CLARKSON MILNS and SAMUEL PICKSTONE, of Ratchiffe Bridge, in the county of Lancaster, manufacturers, for certain improvements in machinery or apparatus used in spinning, doubling, and weaving cotton, flax, and other fibrous substances.—[Sealed 11th Jan., 1851.]

THE improvements which constitute this invention consist, firstly, in the employment of apparatus for conveying moisture to cotton and other fibrous materials while in progress of

being spun ; secondly, in the application to doubling-machines of a roller or rollers for conveying moisture to the yarns in progress of being doubled, or for operating upon the surfaces of the same after they have been moistened by the usual method, so as to effect a smoothing of the fibres ; thirdly, in the application of an arrangement of roller or rollers for conveying starch or other gummy substance to fibrous materials during the operations of spinning and doubling ; fourthly, in the application to spinning and doubling-machines of apparatus for distributing artificial heat, for the purpose of drying cotton and other fibrous materials which have been moistened during the operations of spinning and doubling ; fifthly, in the application of cork washers for effecting the drag of spinning and doubling-machines ; and sixthly, in a method of constructing and adjusting the guides for the "rising shuttle-boxes" of looms.

In Plate XI., fig. 1, represents a partial sectional view of a throstle-frame, with the first improvement applied thereto. The rovings proceed from the creeled bobbins through a series of guides *a*, and thence between two rollers *b*. These rollers are of wood or other suitable material, and covered with cloth or other absorbent substance ; they are of sufficient length to take in the whole range of rovings to be spun ; and the lower one is partly immersed in a trough *c*, containing water. The rollers *b*, turn in bearings at either end ; and the under one is connected to a moving part of the machine, by means of suitable gearing, so that its surface shall revolve at the same rate as the surfaces of the ordinary rollers *d*. The axis of the upper roller *b*, is mounted in slots, so as to press, by its weight, upon the under one, and revolve by friction of contact. By this arrangement of apparatus, the rovings, as they are drawn onwards, will become moistened by the roller *b*, and their fibres therefore be caused to be closer and more even, when they are spun into yarn. It will be necessary to cover the ordinary rollers *d*, between which the rovings pass, with brass or other substance that will not rust.

The second improvement is shewn at fig. 2, which represents a partial sectional view of a doubling-frame. The threads proceed from the creeled bobbins *a*, and thence are conducted through guides *b*, mounted upon the side of a trough *c*, containing the water or other liquid intended to be conveyed to the threads, and in which a roller *d*, is partly immersed. The roller is made of wood, covered with flannel, or other woven cloth, or felt, or other such substance, and provided

with axes, which turn in bearings affixed to the ends of the trough; and on one axis is fixed a toothed wheel *e*, taking into a pinion *f*, on the axle of one of the delivering rollers.

The yarns, after passing through the guides *b*, are carried over the roller *d*; thence around the roller *g*, and back again, so as to pass round the glass guides *h*; and then between the rollers *g*, *i*, to the flyer, as usual. By this arrangement, the roller *d*, will be made to revolve in the direction of the arrow, and its periphery will rub against the yarns which are passing onward in the contrary direction, and smooth down the outside fibres, so as to cause them to incorporate with those composing the main part of the yarns. At the same time, the revolution of the roller in the trough *c*, will constantly supply it with a sufficient quantity of the liquid therein to enable it to transfer the necessary amount of moisture to the yarns, as usually required; and this liquid will also attach together the outside fibres, as they are smoothed down by the rubbing action.

Although in the above description only one roller *d*, is mentioned, yet, if desired, two or more may be employed, acting successively upon the surface of the yarns. Also, in place of the roller travelling in a direction contrary to that of the thread, it may be caused to rotate the other way.

Instead of the arrangement above described, a modification thereof may be adopted, by causing the yarns to pass through water, after the ordinary manner of doubling machines, and be subsequently submitted to the action of a revolving surface or surfaces, so as to effect the required smoothing of the fibres.

In carrying out the third improvement, the patentees substitute for the water in the trough *c*, a solution of starch, or other gummy substance, usually employed for imparting stiffness to textile materials; whereby the rovings (in the case of spinning) will be saturated therewith, and their fibres at the same time smoothed,—rendering the usual subsequent operation of dressing unnecessary.

The fourth improvement is shewn applied to fig. 2. At any convenient part of a doubling-frame, is applied a pipe or chamber *k*, extending throughout the range of bobbins, and connected, at one end, to a steam generator, or other apparatus, capable of generating heat; which, being diffused along the pipe or chamber *k*, will effect the drying of the material, as it is in process of being spun or doubled.

By the adaptation of this drying process to spinning or doubling machines, in which the material has been moistened, the fibres are prevented from rising from their smoothed po-

sition; and, in the case of doubling, the colors of party-colored threads are prevented from running into each other; and a greater clearness of effect is consequently attained.

The fifth part of the invention consists, as before stated, in the use of cork for the "drag-washers" of spinning and doubling-machines. By the substitution of this material less alteration in the drag will take place upon the washers becoming oily, and, consequently, a more even action will be obtained.

The sixth improvement is shewn at figs. 8, and 4,—the former being a sectional elevation of part of the lathe of a loom, provided with a "rising shuttle-box," and the latter a sectional plan view of the same. *a*, is the rising shuttle-box, to the hinder part of which slides *b*, are attached. These slides, according to the ordinary mode of construction, move in guides, one side only of which is adjustable, in order to compensate for slackness, occasioned by wear: consequently, the rising box cannot be kept in the same transverse position, and, by continual wear against the front guide, it protrudes forward beyond its proper situation, so as to obstruct the free passage of the shuttle from the opposite side of the machine. Now the patentees make both sides of the guides adjustable, and are thereby enabled to keep the rising box in a line with the shuttle-race. To the lathe of the loom is affixed a bar *c*, on which is mounted a plate *d*, having a flange, which constitutes one side of the guide for the slide *b*, of the rising box *a*; and upon this plate *d*, there is another plate *e*,—its edge forming the other side of the guide. The plates *d*, and *e*, are capable of moving independently of each other, and of being confined together in any required position by means of tightening bolts, which pass through slots in them, and are screwed into the bar *c*. By this arrangement of parts, the slide *b*, and, consequently, the shuttle-box, may be adjusted in a backward or forward direction, and at the same time kept sufficiently tight in the guide by the independent adjustment of the plates *d*, and *e*. The patentees remark, that they have shewn the outward end of the shuttle-box furnished with guides of the usual arrangement,—there being no positive necessity for the application of their improvement in that situation; but, if desired, it may be adopted.

The patentees claim, Firstly,—the application of water to cotton and other fibrous materials as they pass through the spinning-machine. Secondly,—the application of a revolving surface or surfaces for conveying moisture to yarns as they pass through the doubling-machine, or for revolving in

contact with such yarns after they have been moistened by the usual or other method adopted in doubling. Thirdly,—the application of starch, or other gummy or stiffening substance, to cotton and other fibrous materials, as they pass through the spinning or doubling-machine, by means of a roller or rollers, partly immersed in the starch or other such substance. Fourthly,—the application of apparatus for conveying artificial heat to cotton and other fibrous materials, after they have been moistened in the spinning or doubling-machine. Fifthly,—the application of cork for constituting the drag-washers of spinning and doubling-machines. Sixthly,—so constructing the guides, in which the rising shuttle-boxes of looms work, that each side thereof shall be capable of independent adjustment.—[Inrolled July, 1851.]

To JOHN HARRISON, of Blackburn, in the county of Lancaster, for certain improvements in the manufacture of textile fabrics, and in the preparation of yarns or threads for weaving.—[Sealed 27th May, 1851.]

THIS invention consists, firstly, in improvements upon the methods now practised of effecting a varying positive motion of the cloth-beam of looms, or of the warp-beam thereof, so as to cause a constant length of warp (or nearly so) to be taken up for a given number of picks. This effect is accomplished by two distinct features, which may be used separately or in combination, as may be desired. According to the first of these (and supposing the cloth-beam to be driven) the rod or other apparatus, which gives motion to the driving click, is suspended from the surface of the work in course of being woven; so that, upon an increase of diameter taking place, the rod is caused to rise, and, by shifting its point of connection, with regard to the centre upon which the driving apparatus turns, effect a diminution of action, and thereby a decreased rate of revolution in the work-beam. The second feature consists in the use of ratchet-wheels and catches of peculiar construction or arrangement,—the object being to cause the necessary alterations in the rate of revolution imparted to the cloth or warp-beam, to be effected by changes as nearly as possible approaching to continuous action. Whereas, in the methods usually employed, where positive motions are adopted, the driving click can only vary the rate of revolution by intervals, corresponding to the space of one tooth of the ratchet-wheel—an interrupted rate of progression,

not in constant proportion to the increasing diameter of the work; for, in such arrangement, the undue variation in the rate of drawing off the warp continues, until sufficient gradual alteration in the driving parts shall have been effected to cause the ratchet-wheel to be driven one whole tooth less,—thus causing an abrupt change, which is productive of much irregularity in the fabric. To avoid this, the patentee causes the changes to take place by more frequent steps; and this he accomplishes in two ways,—firstly, by so arranging or constructing the driving parts, that the points of the click or clicks, and the teeth of the ratchet-wheel, are situated obliquely to each other; and, secondly, by the employment of certain apparatus, operating upon the driving-wheel by friction of contact.

The second part of the invention relates to improvements upon the machinery for dressing or sizing yarns, for which letters patent were granted to William Henry Hornby, and William Kenworthy, September 26th, 1839*; and which improvements are also applicable to other sizing or dressing machines, where yarns or threads are passed through the apparatus from beams whereon they have been wound. The objects of this part of the invention are four in number. Firstly,—to gain the opportunity of changing the number of ends required for the weaver's warp, without the necessity of removing one of the beams of the sizing or dressing machine, and replacing it by another of different quantity. This is effected by winding a portion of the ends upon distinct bobbins, which are strung side by side upon an axis, instead of winding them upon beams, as usual; so that, if a warp of fewer ends be required, the change can be accomplished by removing one or more of the bobbins.

The second improvement in this class of machinery consists in mounting the beams, which carry the yarns to be dressed or sized, upon distinct portions of framework, which can be moved independently of each other; and also in the employment of apparatus for raising the yarns or threads, so as to afford space and convenience for the workman to remove a beam, when desired.

The third improvement consists in the application of suitable apparatus for moving and retaining the beams at different elevations, for the purpose of allowing the ends proceeding from one beam to run clear of those proceeding from the others.

* For description of this invention, see Vol. xix. of our present Series, p. 319.

The fourth improvement consists in the employment of a peculiarly-formed brush, for brushing the yarns as they pass through the sizing apparatus.

In Plate XI., fig. 1, is a partial side view of a loom, with portions of these improvements applied thereto; and fig. 2, is a plan view thereof. On the tappet-shaft *a*, is keyed an excentric, that acts upon a rod *b*; and to this rod *b*, is jointed an arm *c*, the upper part whereof carries a rod *d*, that rests upon the work-beam, and by which therefore the rod *b*, is suspended. The outward end of the rod *b*, carries a pin, which works in the slot of a bell-crank lever *e*, that turns upon a centre at *f*, and is continually pressed downwards by a weight *g*. To the bell-crank lever *e*, is jointed a rod *h*, connected by a centre pin *i*, to a lever *j*, vibrating loosely upon a centre *k*; and upon the pin *i*, are mounted a number of driving-clicks *l*, which are kept in position by lugs, extending from the lever *j*. These clicks (in this instance, six in number) take into the teeth of a ratchet-wheel *m*, which drives the warp-beam by any ordinary train of wheels. *n*, are the detaining-clicks, corresponding in number with the clicks *l*. The several clicks of each set are of different lengths,—each one extending behind or before the adjacent click, to the amount of one-sixth of the whole space occupied by a tooth.

Upon the loom being put in motion, the excentric on the tappet-shaft will, through the intervention of the rod *b*, cause the bell-crank lever *e*, to vibrate upon its centre *f*, and thereby carry upwards the rod *h*; which motion will thrust one of the clicks against a tooth of the ratchet-wheel, and effect the taking up of the work; and when this has been effected, the weight *g*, will bring the clicks down to their former position, and keep the rod *b*, in contact with the excentric, ready for another upward motion. Upon the work-beam increasing in diameter, the rod *d*, will rise, carrying with it the arm *c*, and thereby shifting the pin of the rod *b*, in the slot of the lever *e*; the effect of which will be, that the upper arm thereof will be moved by each throw of the excentric through a greater space, and proportionately diminish the lift of the rod *h*, and, consequently, the driving extent of the clicks *l*; and thus the work-beam will be caused to turn a less portion of a revolution, so as to have a constant amount of surface motion. The lower end of the rod *h*, is mounted in a slot of the lever *e*; and therefore, by shifting it backward or forward therein, and adjusting its position by a tightening screw, a permanent alteration may be made in the motion of the driving click or clicks, so as to vary the length of warp drawn

off for a given number of picks, according to the fabric required to be manufactured. In order to explain the gradations by which the change takes place, it will be necessary to refer to figs. 3, 4, and 5, which are diagrams illustrative of the principle. In fig. 3, let *a, b, c, d, e, f*, represent a series of clicks, capable of turning upon a centre-pin, independently of each other, and let the space between 1, and 7, indicate the length of one tooth of the ratchet-wheel. Supposing (for the sake of clearness) that one tooth only be moved at a time, the operation will be as follows:—As long as no change takes place, the click *a*, will travel to and fro between 1, and 7, moving the wheel through that space at each vibration, and assuming, alternately, the positions represented at figs. 3, and 4. Now, supposing that its sphere of action were diminished, so that it carried the line 1, through $\frac{1}{2}$ only of the tooth, its return-motion would then bring it into the position of fig. 5; and, if acting alone, it would travel to and fro without producing any effect upon the ratchet-wheel; but it will be observed that the click *b*, has now assumed a position coincident with the line 1, and will therefore carry forward the ratchet-wheel through a space equal to $\frac{1}{2}$ of a tooth at the next vibration. If the motion of the clicks be now reduced another sixth, that represented at *c*, will drive the ratchet-wheel forward $\frac{1}{3}$ of a tooth; and so on at each change.

In the figures above referred to, the clicks are so disposed as to range in a direction oblique to the teeth of the ratchet-wheel; but the same effect may be produced by employing one click only, acting upon a wheel provided with several sets of teeth, arranged obliquely across its periphery. Fig. 6, represents this arrangement in partial plan view. *a, b, c, d, e, f*, are portions of several ratchet-wheels, united so as to move bodily together,—or the whole may be cast in one piece. The teeth of these are placed in advance of each other, at intervals of $\frac{1}{6}$ th of a tooth; and therefore, upon motion being communicated to the single click *A*, the effect will be the same as described in reference to figs. 3, 4, and 5; for, as a diminution of vibration is effected, the click will progressively act upon the teeth placed in advance of each other, and thus diminish its driving effect by spaces corresponding to $\frac{1}{6}$ th of a whole tooth.

The other method of actuating the driving-wheel for taking-up, is shewn at fig. 7. *p*, is a drum, to be substituted for the driving ratchet-wheel usually employed: the periphery is grooved, with lines cut at an angle to each other, so as to constitute a roughened surface. Upon the axle of this drum

is mounted (so as to be capable of turning loosely thereon) a lever *q*, on which is jointed an arm *r*,—one end thereof being connected to a rod answering to that shewn at *h*, in fig. 1, and the other carrying, by means of a joint-pin *v*, a concave-formed piece *e*, provided with a block of leather, or other slightly-yielding substance. Above this apparatus there is a lever *s*, turning on a centre-pin *t*, fixed to any convenient stationary part of the loom, and carrying a concave surface *u*, similar to that shewn at *e*. Upon an upward motion being given to the rod *h*, through the agency of the parts described in reference to figs. 1, and 2, or by other means, the arm *r*, will be turned upon its centre of motion, so as to press the concave piece *e*, against the periphery of the drum *p*,—the centre-pin *v*, providing for a concentric contact of the two surfaces. A further upward motion of the rod *h*, will now cause the drum *p*, to turn a portion of a revolution, and thus, through the intervention of any ordinary train of gear, afford the necessary taking-up of the work. During this action, the periphery of the drum will have slipped past the concave surface *u*,—the lever *s*, yielding by turning upon its centre-pin *t*. On the rod *h*, descending, the arm *r*, will turn in a reverse direction, so as to bring the surface *e*, free from the periphery of the drum, and restore it to its former position, ready for again effecting the taking-up motion. A retrograde motion of the drum *p*, is prevented by the action of the surface *u*; inasmuch as the roughened periphery will not allow a slipping to take place; and the stud *t*, will prevent the arm from turning downwards upon its centre; for, to accomplish that movement, the thick dotted lines, shewn at fig. 7, must be straightened: an effect which cannot be produced, as the outward end of each is a fixed point. In this arrangement, the change of extent in the taking-up action is not governed by any definite points upon the driving-wheel; but every minute alteration given to the motion of the rod *h*, by the method shewn at fig. 1, or by other means, will effect a corresponding change in the extent of revolution imparted to the work-beam.

If desired, the improved method of regulating the extent of motion communicated to the driving-wheel, may be applied in conjunction with ordinary clicks and ratchet-wheels; and the improved construction of clicks and ratchets, and also the apparatus described in reference to fig. 7, may be used with other arrangements of parts, for governing the extent of their action: they are merely shewn together for the convenience of description. Either of the improvements may be applied to the purpose of letting off the warp, instead of taking up

the woven fabric : in which case the work-roller may be turned by weights, as is well understood.

The improvements in dressing or sizing machines are shewn at figs. 8, and 9 ;—fig. 8, being a side elevation of part of a machine, upon the patent principle of Messrs. Hornby and Kenworthy, and fig. 9, an end view thereof. Instead of using a beam the whole width of the machine, the patentee mounts a series of bobbins *a, b, c, d, &c.*, upon an axis, and secures them thereto, so that they shall all revolve together, by square sockets, or by any other ordinary method. The yarns or threads are wound upon these bobbins in the usual manner, and conducted through the machine, together with those of the other rollers, as is now practised.

By this arrangement, a facility is afforded for winding weavers' warps, of various numbers of ends, without the necessity of changing an entire beam. Thus,—supposing the whole widths of the several beams to contain a warp of 2600 ends, and that upon which the improved bobbins are mounted to contain 500 of that number,—if it be desired to produce a warp of 2500 ends, it is evident that this may be done by removing one of the bobbins *a, b, c, &c.* ; for such removal will reduce the whole to the required number. The reduced number of ends now upon the bobbins may be caused to diverge, and be distributed so as to spread to the width of the others at the guide-combs.

The patentee says, he has assumed that only one of the beams is constituted by the improved application of bobbins ; but, if desired, two or more may be so fitted up, in order to gain the opportunity of winding a more varied assortment of warps.

The second improvement, under this head of the invention, consists in the following arrangements. The beams *A, B, C, D, E*, on which the ends are wound, are mounted in bearings, carried by distinct portions of framework *f, g, h, i, j* ; and these are furnished, at their lower ends, with rollers *k*, to run upon rails *l*, affixed to the flooring, so that the frames may be moved upon the rails independently of each other. The ends, as they pass from the beams *A, B, C*, are conducted over guide-rollers *m*, which, in this instance, are supported by separate sockets *n, n**, capable of sliding upon vertical rods *o, o**. To the sockets *n*, are attached cords *p*, which pass over guide-pulleys *q*, and thence over other guide-pulleys *r*, at the opposite side of the machine ; and to the sockets *n**, are also attached cords *p**, which extend upwards, and, being united to the other set *p*, pass around the pulleys *r*. These cords

hang downwards within reach of the attendant; so that, by pulling them, he can at pleasure raise the guide-rollers *m*, and the yarns or threads which pass over them, separately, or together. Suppose it be desired to remove one of the beams *A*, *B*, *C*, (*C*, for instance), the attendant will move the frames *f*, *g*, outward upon the rails,—at the same time, by means of the cords *p*, *p*^{*}, raising their respective sockets *n*, *n*^{*}, and guide-rollers *m*; which operation will bring the parts into the position shewn by the dotted lines in fig. 8,—thus affording head-room for facilitating the desired removal of the beam. The ends proceeding from *D*, *E*, do not pass over the series of guide-rollers; when, therefore, it is desired to remove them, in order to gain access to that beam shewn at *r*, a spare roller is placed under each of the series of ends belonging to *D*, and *E*, and then lifted into the two vacant sockets *z*; and these sockets being then raised, and the separate portions of framework moved out, as before described, the desired space is obtained.

In effecting the third improvement, the patentee mounts the beams *A*, *B*, &c., in bearings *s*, capable of moving up and down in guides affixed to the side framing. These bearings have racks formed upon their edges, into the teeth of which the detaining clicks *t*, enter; and therefore, by shifting the clicks into different teeth, the operator is enabled to vary the position of the beams in a vertical direction. Thus, supposing the beam *A*, to be so diminished in diameter, that the ends proceeding therefrom would run upon those passing from *B*, the position of the clicks is altered, so as to raise the axis of *A*, and thereby remove the yarns or threads thereof from contact with the other series; or the same thing may be effected by lowering *B*, provided the level of the ends from *E*, will admit of such an arrangement.

The improved brush, which constitutes the fourth part of this head of the invention, is shewn applied at *w*, fig. 8. It extends across the width of the machine, and has three distinct portions, so as to come into operation upon the sized yarns or threads at intervals; and it is caused to revolve by any suitable connection with the moving parts of the machine. By this arrangement, the brushing medium is not always in contact with the yarns or threads, and therefore does not confine them to that disposition in which they advance upon it; but, by alternately brushing and leaving them, will enter fresh points, and thus, in great measure, effect a division, so as to operate upon them in detail.

Although the above improvements are described as com-
VOL. XL. 2 s

bined in one machine, they may, if desired, be used singly or in any other combination, and applied either to the patent machine of Messrs. Hornby and Kenworthy, or to those of other constructions.

The patentee claims, as applied to looms for weaving, Firstly,—the application of a surface, in contact with the work-beam, for regulating the vibration of a lever or levers, to which the driving-click or clicks of the ratchet-wheel are connected; also the application of the like apparatus for the purpose of letting off the warp. Secondly,—arranging the driving-click or clicks and teeth of the ratchet-wheel or wheels obliquely to each other, whether applied to taking up the work or letting off the warp. Thirdly,—the application of a surface, acting against a roughened periphery, for the purpose of taking up the work or letting off the warp.

As applied to machines for sizing or dressing yarns or threads, he claims, Firstly,—dividing one or more of the beams or rollers upon which the yarns or threads are wound, so that a portion or portions thereof can be removed at pleasure. Secondly,—mounting the beams or rollers upon separate portions of framework; and also the application of suitable apparatus for raising any desired portion of the yarns or threads for the purpose above set forth. Thirdly,—mounting the beams or rollers in bearings, capable of being raised or lowered, in order to clear their yarns or threads from those of an adjacent beam or roller. Fourthly,—the application of a brush which does not act continuously upon the yarns or threads.—[*Inrolled November, 1851.*]

To JOHN ROWLAND CROOK, of Birmingham, in the county of Warwick, hatter, for improvements in hats, caps, and bonnets.—[Sealed 11th September, 1851.]

THIS invention relates particularly to the class of hats termed "silk hats,"—the object of the improvements being, to make them lighter, softer, more elastic, and better ventilated than usual.

In the ordinary course of manufacture, the crown, body, and brim of the hat are made of three separate pieces, each composed of two or three thicknesses of calico, or other flexible material, and the whole cemented together by a solution of shellac: which process is technically called "priming." Now the patentee makes these parts, or the entire foundation of the hat, of one piece, without any seam or joining, and of

one thickness, except at the edges, and other places where strengthening pieces are introduced. Or he makes the body only of one piece of one thickness, and the crown or brim of a separate piece or pieces. The material employed for the body and crown is palm leaf or Brazilian grass plait; but, for the brim, willow is preferred, on account of its greater stiffness and porousness. The palm leaf or Brazilian grass is first roughly plaited into the form of the intended hat, cap, or bonnet; then soaked in boiling water; and finally moulded on a block into the shape required to be permanently given to it. In order to facilitate the moulding of the piece of plait into the proper form, a small piece is cut out at the centre of the crown, and the opening filled with a piece of scale-board, mill-board, calico, or other suitable stiff but light material. To strengthen the hat at the places most exposed to wear (such as the edges of the brim and crown), pieces of tape, or strips of net, or other suitable binding material, are cemented to the foundation at those parts. After the foundation of the hat has been blocked out and strengthened at the parts most exposed to damage, the whole is varnished over, and then covered with silk or cotton plush, in the manner now commonly practised. The palm leaf or Brazilian grass is rendered repellent of water by steeping it, either before or after plaiting, in some waterproof composition, such as soap and alum, or copal varnish; but the patentee does not make any claim to the use of such waterproof composition.

What the patentee claims as his invention, in regard to the manufacturing of silk hats, caps, and bonnets, is, the making of the foundation of the hat of one entire piece of palm leaf or Brazilian grass, rendered water-repellent by the means aforesaid, and without seam or joining, or need of "priming," and of one single thickness throughout, except at the edges, and other places where strengthening pieces are requisite, as before described; or making the body only of one piece of one thickness, as aforesaid, and the crown or brim of a separate piece or pieces.—[*Inrolled March, 1852.*]

To HERMAN SCHRODER, of Bristol, Gent., for improvements in manufacturing and refining sugar.—[Sealed 15th April, 1851.]

THIS invention relates to apparatus for evaporating and granulating cane-juice, or liquids containing saccharine matters

capable of crystallization, and consists in combining a pan or vessel, heated by means of steam or other fluid (contained in, or passing through, a pipe, or series of pipes, inserted in, or extending through, the pan or vessel), with a series of discs or surfaces, which move or revolve partly immersed in the liquid to be evaporated and granulated. By the revolution of the discs, the heated particles of cane-juice, or saccharine liquid, are brought into contact with the air; and thereby evaporation to a great extent is carried on at a temperature below the ordinary boiling point of the liquid.

The patentee prefers the shape of the pan or vessel to be that of a segment of a cylinder; but he does not confine himself thereto; nor does he confine his invention to any particular shape of pipe, or arrangement of pipes or passages, for conveying heat to the liquid. The apparatus preferred to be used is represented in Plate XI., where *a*, is the evaporating pan; *b*, a revolving disc; *c*, the pipe that supplies steam to the bent pipe *d*; and *e*, the pipe that carries off the water produced by the condensation of the steam. The temperature is regulated by cocks, or other suitable means.

The claim made by the patentee is for the combination of moving or revolving discs or surfaces with pans or vessels, heated by pipes, or tubes, or passages, containing steam or other heated fluid.—[Inrolled October, 1851.]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for certain improvements in the construction of railways,—being a communication.—[Sealed 12th June, 1850.]

THIS invention has for its object the construction of the permanent way of railways in a more secure and stable manner than is usually done at the present time; and also the arranging the two lines of rail, upon which the carriages are intended to run, in such a manner that, in the event of a portion of one line getting loose, or out of order, such derangement shall not materially affect the other line, as is now the case when both lines of rail are secured to the same transverse sleepers.

In the present improvements, the use of transverse sleepers is dispensed with, and, in place thereof, the cast-iron chair is cast on a plate, of such form and dimensions as to resist the downward pressure of heavy weights, as well as lateral dis-

placement by the wheels of the carriages. To preserve the rails in their parallel position, and prevent the sleepers or bearing-plates from being displaced sideways, the under surface of the said sleepers has cross flanges, or projecting ribs, cast thereon; one of these flanges or ribs runs parallel with the rails, and, being sunk into the ballast, resists any lateral pressure; while the other flange or rib runs at right angles to the rail, and serves to give strength and stiffness to the sleeper, and also prevents any longitudinal displacement. In order further to secure the perfect parallelism of the rails, the sleepers are connected transversely by wrought-iron rods or bars, which will not have any other effect upon the sleepers than to prevent them from moving asunder transversely; leaving the sleepers otherwise perfectly independent of each other; so that, if one sink, it may be raised and properly adjusted without interfering with the sleeper at the opposite end of the transverse rod or bar. It is not, however, absolutely necessary to employ this tie-rod; and therefore it may, under some circumstances, be dispensed with.

In Plate X., fig. 1, represents a vertical section of the improved sleeper and chair, intended to support the joint between two adjoining rails; fig. 2, is a plan view thereof; fig. 3, is a view of the under side of the sleeper, and represents a section, taken in the line *c, d*, of fig. 1; fig. 4, is a vertical section, taken in the line *e, f*, of fig. 1; fig. 5, is a similar view of a chair and sleeper, for supporting an intermediate part of the rail; and fig. 6, is a horizontal section thereof, taken in the line *A, B*, of fig. 1. The jaws of the joint-chair are constructed in such a manner that the two rails may be secured separately in the chair, by means of separate keys or wedges, as seen best in fig. 2. For this purpose, the outer jaw of the chair is divided into two parts *d*, and *d**; so that the ends of the rails *a*, and *a**, may be secured in the chair by means of separate keys or wedges *b*, and *b**, in order that either rail may, if required, be removed without disturbing the other. The patentee here remarks, that, although the chair is constructed in the manner just described, still it is only one single chair. This chair may also be applied to ordinary sleepers: that is, instead of having a chair, of the peculiar form just described, cast on an iron sleeper, the chair may be cast separately, as usual, and secured to a wooden or other sleeper in the ordinary manner. The ends of the transverse rod or tie-bar *i*, are formed with a head, which, being dropped into a socket in the chair, securely holds the two chairs together without any other fastening. *c*, is the inner jaw, and *d*,

the outer jaw of the chair,—the outer jaw in fig. 2, being divided, as already described. *e*, is a socket or hole, for receiving the head of the transverse bar *i*; *f*, is the table or horizontal part of the sleeper; *g*, is a deep feather or projecting rib, formed on the under side of the sleeper, for strengthening it, and causing it to resist any shocks that might otherwise break it, or cause any longitudinal displacement; *h*, is another projecting feather, placed at right angles to the former, and intended to prevent the sleeper from slipping or moving sideways; and *j*, is a feather, or projecting edge, formed on the upper side of the sleeper, for the purpose of strengthening the same, and supporting the jaws of the chair.

The patentee says, he is aware that cast and wrought-iron sleepers, having chairs cast or secured thereon, have heretofore been used for supporting the rails of railways. He does not, therefore, intend to lay claim to the exclusive use of sleepers and chairs cast in one piece, except when they are constructed and applied according to the present improvements. What he claims is, the peculiar form and construction of the cast-iron sleeper or bearing-plate shewn in the drawings, with a chair cast thereon;—particularly, dividing one of the jaws of a joint-chair into two parts, in order that the ends of the two rails may be held or fastened separately, and in a more secure manner than by the ordinary modes of fastening; so that if one rail should require to be moved, this operation might be effected without interfering with the other rail;—and he claims this mode of constructing chairs, whether employed in conjunction with the other improvements above set forth, or adapted to any of the ordinary kind of sleepers. He also claims connecting two opposite bearing-plates or sleepers together by means of a transverse bar or tie-rod, the ends of which, by taking into holes or sockets made in the sleepers, will thus securely hold them together, without any other fastening.—[Inrolled December, 1850.]

To RICHARD ARCHIBALD BROOMAN, of the firm of J. C. Robertson and Co., of Fleet-street, for improvements in railways,—being a communication.—[Sealed 7th November, 1850.]

THIS invention consists in a method of joining together or connecting the ends of the rails of railways, so as to keep

the upper surfaces thereof flush with each other, and at a uniform level.

In Plate X., fig. 1, represents a side view of the ends of two U-shaped or bridge rails, connected according to this invention; fig. 2, exhibits the end of one rail, with the connecting-piece or coupling-bar; and fig. 3, is a transverse section of the rail and coupling-bar. The connecting-piece or coupling-bar *a*, is made of wrought-iron, of a suitable shape to fit tightly into the hollow or cavity in the under part of each rail; and, when it has been inserted therein, it is secured to the ends of the adjacent rails by rivets *b*: if preferred, however, screw-bolts or keys may be substituted for the rivets. The rivet-holes, at one end of the coupling-bar, are made of an oblong form, as shewn at fig. 2, to allow for the expansion and contraction of the metal. One rail only is, in the first instance, rivetted to the coupling-bar; and, after this has been laid in its place, the other rail is rivetted to it. The patentee remarks, that the joint thus produced is perfectly stiff, both vertically and laterally, and yet, at the same time, it permits sufficient play for the expansion and contraction due to differences of temperature.

He claims the connecting the different lengths of U-shaped rails, end to end, by means of coupling-bars of wrought-iron and rivets or bolts, as before described.—[*Enrolled May, 1851.*]

To FLORIDE HEINDRYCKX, of Brussels, in the Kingdom of Belgium, engineer, for improvements in propelling.—
[Sealed 15th April, 1850.]

THIS invention relates to that description of apparatus used for propelling vessels, commonly known as stern-propellers,—such as the screw, or any modification of the screw.

The improved propeller, which is intended to be employed in place of the screw, consists merely of two vanes or wings, attached to an arm or arms, fixed on, or secured at right angles to, the main or propelling shaft. These vanes or wings, which may be called the propellers, are constructed, by preference, of some highly-elastic material, such as steel, or wrought-iron, or any other material that will resist the strain to which it will be subjected. Wood may be used, if thought desirable. The patentee does not, however, intend to confine himself to the use of any particular material, so long as a proper amount of elasticity can be obtained.

In Plate X., fig. 1, represents a front elevation or end view

of the improved propeller; fig. 2, is a side or edge view; and fig. 3, is a plan view of the same, as seen from above. *a*, is the main or driving-shaft, to which the propellers *b*, *b*, are firmly secured by means of the cross piece or transverse bar *c*. The dimensions of the propellers or vanes vary; and they are more or less inclined, according to circumstances. Their stiffness or rigidity must also depend upon the size and form of the vessel they are intended to propel. In order to bring the improved propeller within the same space as that occupied by the screw which it is intended to supersede, the outer angles or corners of the vanes or propellers may, if thought desirable, be rounded off. Fig. 4, is a side elevation of the after part of a vessel, shewing the propeller mounted in its place on the main or driving-shaft *a*, in the same manner as the screw; but, if thought desirable, two propelling apparatus may be used,—one on each side of the stern-post, instead of only one, situated immediately behind it, as shewn.

The patentee observes, in conclusion, that he does not intend to confine himself to any particular dimensions for the vanes or propellers; nor to the form, or inclination, or angle shewn; nor yet to the material of which they are to be constructed; as all these points admit of considerable variation, according to the circumstances under which the improved propellers are to be employed. What he claims, as his invention, is,—mounting two or more elastic inclined vanes or wings on an arm or arms, fixed or attached transversely to the main or driving-shaft, and causing those vanes or wings to rotate with the shaft; so that, by acting on the water, they may propel the vessel through the water.—[Inrolled October, 1850.]

To CHARLES DE BERGUE, of Arthur-street West, in the City of London, engineer, for improvements in, and in the construction of, the permanent way of railways.—[Sealed 7th February, 1851.]

THIS invention consists, firstly, in a mode or modes of constructing iron longitudinal bearers or sleepers, for more effectually supporting the rails of permanent ways. For this purpose, the longitudinal bearers are constructed according to the principles that commonly govern the construction of iron girders (in order to obtain as much strength as is practicable, without unnecessarily increasing the quantity of metal), by so disposing the metal, or disposing and combining the

metals of which they are composed, as best to resist the strains to which they are subjected, by reason of the inequalities of the ground or ballast—being chiefly tension at the lower portion or base, and compression at the upper portion. In accordance with this object, the bearers are made of such forms that the bases or bottoms shall be considerably stronger or (if wholly of cast-iron) have a greater transverse sectional area than the upper portions;—in every case, the upper parts being made of suitable forms to receive and support the descriptions of rails to be placed upon them.

Secondly, the invention consists in the employment, with longitudinal bearers or sleepers, of transverse iron ties or bearers, in cross section presenting an appearance like the letter T inverted—thus $\perp$; so that the ends of any longitudinal bearers or sleepers, having flat bottoms, may rest upon the tie, which will assist in keeping the longitudinal sleepers steady, and prevent them from canting.

Thirdly, this invention consists in certain forms of rails,—namely, an angular rail, made so as to fit against one side and on the top of the longitudinal bearers or sleepers constructed according to the first part of the invention; and also a saddle-rail, so formed that the interior or under side of the tread or working surface of the rail shall rest upon the upper part of a longitudinal bearer or sleeper,—the sides or flaps of the rail being bent, either to a right angle with the bearing surface of the rail, or to such other angle as may be requisite to make the rail fit upon, and be held more securely by, the top of the bearer or sleeper on which it is placed; or, for this purpose, instead of bending each of the sides or flaps to the same angle, one side may be bent to one angle, and the other side to another or different angle.

In Plate X., fig. 1, exhibits a transverse section of the angular rail *a*, supported by the longitudinal bearer or sleeper *b*, to which it is connected by screw-bolts *c*, and nuts *d*. Fig. 2, is a transverse section of one form of saddle-rail, secured upon a longitudinal sleeper *b*, by screw-bolts and nuts. Figs. 3, and 4, exhibit transverse sections of a saddle-rail of another shape,—one side of which is formed suitably for fitting close to the inclined side of the sleeper; and, in the other side of the rail, at suitable intervals, are inserted set-screws *e*, the points of which bear against the opposite side of the sleeper. Figs. 5, represent transverse sections of two other forms of saddle-rails. The sleepers shewn at figs. 1, and 2, which are wholly of cast-iron, consist of a single vertical web, terminating in a horizontal base-plate, and strength-

ened laterally by ribs *f, g*. The sleeper at fig. 3, is also made entirely of cast-iron, and is composed of two inclined webs *b'*, united together at the top, and terminating, at the bottom, in a horizontal base-plate. The sleeper represented at fig. 4, resembles, in transverse section, the letter *x*, inverted; it is made of cast-iron, and is connected, at the bottom, by bolts or rivets, to a plate *h*, of wrought-iron; and it is strengthened laterally by ribs *f, g*. If preferred, the sleeper shewn at fig. 3, may be cast without the horizontal portion between the points *i, j*, and bolted or rivetted to a plate of wrought-iron, like the sleeper at fig. 4. The transverse sectional form of the sleepers may be either as represented at figs. 1, 2, 3, and 4, or of any other form which may be deemed best for the purpose—provided that they are constructed upon the principle before-mentioned: *i. e.*, with the base stronger than the upper part.

The improved transverse tie or bearer is shewn in end view at fig. 6, and in side view at fig. 1, with a longitudinal sleeper resting upon it. In shape, transversely, it resembles an inverted T, and is either made of wrought-iron by rolling, or else the ordinary T-iron is used for the purpose. In laying down the longitudinal bearers or sleepers, their ends are so placed as to rest upon the horizontal flanges of the transverse tie, and they are bolted together,—provision being made for expansion and contraction by an enlargement in the proper direction of the holes through which the bolts pass.

The side and top of a longitudinal bearer, against which an angular rail fits, should be planed true to receive it; and so, likewise, the upper surface of the webs, on which the saddle-rails rest, should be planed, or otherwise made sufficiently true, to receive them; or a strip of lead or other metal, or other suitable material, may be introduced between the web and the rail. The rails shewn at figs. 1, and 2, are firmly connected to their bearers by bolts, which may be either square or round; but, in either case, the holes in which they are inserted should be a trifle wider than the bolts, in order to allow for expansion and contraction. Fig. 7, exhibits a saddle-rail applied to a wrought-iron bearer made from an old worn-out rail of the ordinary shape. The original form of the upper portion of the old rail is as represented by the dotted lines; and, when considerably worn away, it is converted into a bearer for the saddle-rail, by planing or cutting, or rolling and planing or cutting, to the form shewn by the full lines.

In laying down the improved permanent way, the longitudinal bearers and rails are so disposed, relatively to each

other, that the junction of any two lengths of the latter may be midway, or at some intermediate distance, between the junctions of the former. If ordinary transverse wooden sleepers are preferred to be used instead of the transverse ties above described, the ends of the longitudinal bearers may be made to abut, either square or obliquely, against each other: the latter method will tend to prevent the transverse sleepers from rocking. In either case, the ends of the longitudinal bearers or sleepers are connected to the transverse sleepers by bolts, with a washer above, and a triangular nut below, as practised on the Great Western Railway.—[*Inrolled August, 1851.*]

To STEPHEN MOULTON, of Bradford, in the county of Wilts, India-rubber manufacturer, for certain improvements in the preparation of gutta-percha and caoutchouc, and in the application thereof.—[Sealed 14th August, 1851.]

THIS invention consists in the discovery of a new combination of several materials, by which a new and valuable compound is produced.

It is a fact well known to persons acquainted with the native gutta-percha, that it is very materially affected by the change of climate; that it becomes rigid when exposed to a low degree, and soft when exposed to a high degree of temperature; that it does not at any time possess any elastic properties; and that these liabilities to change with the climate, and also its non-elastic qualities, prevent the native gutta-percha from being applied to a great variety of useful purposes. Now one part of this invention consists in obviating these disadvantages, by combining gutta-percha with a mixture of sulphite or hyposulphite of lead or zinc and the artificial sulphuret of lead or zinc, and submitting the compound to the action of a high degree of heat: whereby a material is produced, which the patentee calls cured gutta-percha, possessing the quality of elasticity, unaffected by changes of temperature, and resisting the solvents of the native gum. The mode of making the compound is as follows:—After the gutta-percha has been cleansed from its impurities, the patentee takes one or more pounds weight of it, as can be conveniently ground or mixed at a time, and adds from two ounces to half a pound of the sulphite or hyposulphite of lead or zinc and the artificial sulphuret of lead or zinc, in about equal proportions of each, together with from two to twelve ounces of Paris white or powdered chalk; and he grinds the whole between heated rollers, and treats the mixture in the manner set forth in the

specification of his patent of February 8th, 1847, for "improvements in treating caoutchouc with other materials, to produce elastic and impermeable compounds:"* to which specification he particularly refers for the mode of carrying out this part of the invention.

The invention further consists in combining one part of gutta-percha and one part of caoutchouc, or, as the case may require, a greater or less proportion of either the one or the other, with the sulphite or hyposulphite of lead or zinc and artificial sulphuret of lead or zinc, in about equal proportions of each. One pound weight of the compound of gutta-percha and caoutchouc is combined with from two to six ounces of the before-mentioned materials, to which, as a dryer, from two to twelve ounces of powdered Paris white or chalk are added; and this compound is prepared and treated in every respect the same as gutta-percha alone. The same machinery is used; and it is exposed to the same degree of heat;—producing a fabric, equally as valuable for many purposes, rather more elastic, but not as capable of so perfectly resisting the action of oils as when gutta-percha alone is used.

When it is desired to produce a hard-cured gutta-percha composition, or gutta-percha and caoutchouc composition, similar to horn or ivory, from two to twelve ounces of calcined magnesia are added to each pound of gutta-percha compound, alone or combined with caoutchouc; and the compound is treated in all respects the same as when the magnesia is not used.

After the gutta-percha, or the gutta-percha and caoutchouc, has been ground and mixed, the compound is still liable to be affected by changes of temperature and the action of solvents, the same as in the natural state: to prevent which, the compound, whether in the form of coated cloth, sheet gum, moulded or any other article, should be placed in a room or vessel as nearly air-tight as possible, and subjected to steam or dry heat of from 250° to 350° Fahr. The time required for thus curing the compound will vary from two to ten hours, or thereabouts, according to its thickness, and the quantity of the goods put in a mass together for this part of the process of the manufacture.

After the goods have undergone the curing, as above (if properly done), they will be found not only impermeable to wet, but extremely tenacious, possessing the elastic property of the cured caoutchouc, and also unaffected by changes of temperature.

* For the specification of this invention see Vol. xxxi. of our present Series, p. 123. By a typographical error, the word "hyposulphate" is substituted for "hyposulphite" throughout the description here referred to.

What the patentee claims, as his invention, is the use, in combination with gutta-percha alone, or with gutta-percha and caoutchouc, of the acids of sulphur of a lower degree of oxygenation than the sulphuric acid, in combination with suitable bases; but he prefers a hyposulphite, which can be used alone, or in combination with the salts of the acids of sulphur, or with the sulphurets, substantially as above described. Also, the use of the artificial sulphurets of lead and zinc, in combination with Paris white or chalk, used with the gutta-percha alone, or gutta-percha and caoutchouc, or with a salt of a lower degree of oxygenation than a sulphate, and artificial sulphuret of lead or zinc, substantially as above described. And he further claims the treating of gutta-percha, either alone or with caoutchouc, by combining therewith calcined and carbonate of magnesia and hyposulphite of lead, and the artificial sulphuret of lead or zinc, and subjecting it to a high degree of temperature, as above described.—[Inrolled February, 1852.]

To LOCKINGTON ST. LAWRENCE BUNN, of Walbrook, in the City of London, merchant, for improvements in the manufacture of kamptulicon.—[Sealed 7th August, 1851.]

THIS invention relates to the composition known as "kamptulicon," which formed the subject of letters patent granted to E. Galloway, February 14th, 1844, under the title of "certain combinations of materials, to be used as a substitute for canvas and other surfaces employed as grounds for painting,—some of which combinations are applicable to other purposes."*

The object of the first part of the present invention is to give strength and firmness to the kamptulicon, to render it more durable, and to prevent its contraction when subjected to different temperatures. This the patentee proposes to effect by placing any woven fabric (preferring an openly-woven canvas), wire-gauze, or perforated metal, between two thin sheets or layers of kamptulicon, which are caused to adhere to each other by penetrating through the reticulation of the canvas or other material. The masticated caoutchouc is combined with cork-dust or other matters, as usual, and rolled or spread over the two sides of the canvas, wire-cloth, or other reticulate material; and, when dry and cold, one or both sides are painted and ornamented, according to the uses to which the sheets so prepared are to be applied; or there may be a surface of canvas or other woven fabric on the outside to be painted and ornamented.

* For description of this invention see Vol. xxv. of our present series, p. 235.

The second part of the invention consists in coating the surfaces of sheets or blocks of kamptulicon (either prepared according to the first improvement, or not) with kamptulicon colored in the mass by the addition of suitable pigments: this may be effected by dyeing or staining the cork-dust before mixing it with the caoutchouc; or by mixing suitable pigments with the cork-dust so stained. In some cases, the patentee uses India-rubber or other solution to unite the colored to the uncolored kamptulicon, in preference to the employment of heat or rollers.

The last part of the invention consists in manufacturing the kamptulicon into mosaic and other patterns, for pavements and other purposes. The kamptulicon is colored in the masticator, by the addition of pigments or coloring matters; and, while in a plastic state, it is pressed or moulded into different forms. Pieces so formed, of various colors, are placed side by side, to form any required pattern, and cemented together by India-rubber solution, or other suitable adhesive material; and the combined mass is cut into sheets or veneers, which are either employed in that form or cemented to sheets or blocks of kamptulicon.

The patentee claims, as his invention, First,—the application of woven fabrics, wire-gauze, perforated metals, or other similar materials, between two layers or sheets of kamptulicon, and printing and ornamenting the same as described. Secondly,—the manufacture of sheets, blocks, or layers of kamptulicon, combined with pigments or other coloring matter, on to other kamptulicon in an uncolored state. Thirdly,—the manufacture of kamptulicon into mosaic or other patterns, either for pavements or other purposes.—[*Inrolled February, 1852.*]

To CHARLES BARLOW, of Chancery-lane, London, Esq., for improvements in propelling,—being a communication.—
[Sealed 11th January, 1851.]

THE subject of this invention is an improved construction of paddle-wheel for propelling vessels. The improvements consist, firstly, in the paddles or blades being of a curved winding form, set obliquely between the two rims of one section of the paddle-wheel; and, secondly, in making the paddle-wheel in two sections, with curved winding blades or paddles exactly alike, but set in opposite directions on the two sections, and leaving a space between the two sections all round the wheel.

In Plate XI., fig. 1, is an edge view and fig. 2, a side view

of the improved paddle-wheel. *a*, is the shaft, on which there are four bosses or collars *b*, furnished with collar-plates *c*; these plates *c*, carry the radial arms *d*, which are bolted thereto; and to the arms *d*, are bolted the rims *e*, of the wheel, and the circular strengthening bands or stays *f*. The paddles or blades *g*, are of a curved winding form, but of the same breadth from end to end; each is turned up at the ends to form flanges, which are bolted to the arms *d*; and each paddle is placed at an equal distance from the adjacent ones, and set obliquely between the rims, at the angle indicated by the dotted lines. There is a space *h*, all round the wheel, between the two sections of which it is composed. The two inner rims of the wheel may be connected together by bolts, to give additional strength. It is stated by the patentee, that the points in which this paddle-wheel differs from others are,—first, the curved and winding form of the blades, set obliquely, which enables them, by entering the water edgewise, to prevent jarring—to act effectually on the water while passing through it—and, when leaving the water, to avoid what is termed “water-lift;” and, secondly, the two sets of paddles, placed opposite to one another, with a space between; to act upon the water while passing through it, to gather the water towards the middle of the wheel, where the water is not acted upon by the paddles,—thus forcing a portion of the water forward, while some is forced behind; and thus, by the action and re-action of the water, a solid or firm fulcrum of water is presented for every paddle to act upon to propel the vessel, and what is termed the slip of the paddles is prevented.

The patentee claims, as the invention communicated to him, First,—a paddle-wheel, constructed with curved winding blades or paddles, set obliquely between the rims of the wheel, for the purpose specified. Secondly,—the paddle-wheel formed with double sets of curved winding blades, set obliquely and opposite to one another on the two sections of the wheel, with a space between the sections all around the circumference, as represented and described, for the purposes set forth.—[*Inrolled July, 1851.*]

To WILLIAM HENRY RITCHIE, of Kennington, in the county of Surrey, Gent., for improvements in ornamenting glass,—being a communication.—[Sealed 2nd October, 1851.]

WHEN ornamenting glass, it has been the practice, in some cases, to apply enamel over the surface in a semi-fluid state,

and, when dry, to scrape off or remove portions thereof by suitable instruments, according to the pattern or design to be produced,—the parts remaining (after being fixed, and the glass annealed), exhibiting the pattern in white or colored enamel. In other cases, the surface of the glass has been ornamented by placing lace or other open or reticulate fabric or material thereon, and then laying on the enamel (white or colored, according to the effect desired); so that the pattern produced is that which results from the glass having enamel on those parts which have not been covered by the substantive parts of the lace or other reticulate material.

Now, according to this invention, although lace or other reticulate fabric or material is employed, it is not used at the time of laying on the enamel, but afterwards, and then for the purpose of removing the enamel from those parts of the glass where the open parts or perforations of the fabric or material come,—the parts of the enamel which are covered by the substantive parts of the lace or other open fabric or perforated material being thereby prevented from being removed. In carrying out the invention, the glass is coated with enamel, and dried, as heretofore; then the lace or other open, or perforated, or reticulate material, is placed on the dried enamelled surface; and the parts of the enamel which are not covered by the substantive parts of the lace or other reticulate or perforated material, are removed: this may be readily done by means of a soft brush. When fabrics, such as lace, are used, they are distended in a frame, which is kept suspended above the table whereon the process of enamelling is performed; and the frame is drawn down and kept closely pressed upon the surface of the glass (which is most conveniently done by weights, attached to the frame) during the operation of removing the desired portions of the enamel. This is also the best mode of working, when perforated paper or other like thin flexible fabric or material is employed in frames. The portions of enamel remaining upon the glass are fixed by heat, and the glass annealed in the ordinary manner.

The patentee states that he does not confine himself to the precise details above given. He claims the mode of ornamenting glass, above described, whereby lace and other reticulate or perforated fabric or material is employed, when removing parts of the enamel or ornamenting material from the glass.—[*Inrolled April*, 1852.]

Scientific Notices.

ON THE MANUFACTURE OF ACETIC ACID,

AND ITS APPLICATION TO THE MANUFACTURE OF WHITE-LEAD.

LIKE many of the most ancient manufactures, the fabrication of acetic acid has latterly received very important modifications, from the application of chemistry to its various processes, and few arts exhibit in a more conclusive manner the great advantage of understanding first principles than the present system of making vinegar, when contrasted with the old one. From the earliest ages, up to within a very recent period, the nature of the change induced in an alcoholic fluid during its conversion into vinegar, was a complete and total mystery. The simple fact had indeed been developed, that, under certain circumstances, wine and other fermented fluids would become sour and ultimately produce vinegar; but how or why this occurred, or in what way it was to be retarded or promoted, were subjects hidden from the philosophy even of the last century. To hope for improvement in such a condition of things, was like trusting to chance or relying upon accident; consequently, improvement there was none. At length, however, organic chemistry not only disclosed to mankind the composition of alcohol and acetic acid, but also pointed out the means by which the former of these might be converted into the latter; and now, nothing in the whole range of science is more clearly defined or better understood than the conditions needed for the sure and rapid formation of vinegar.

Acetic acid may be briefly described as alcohol oxidized; and any circumstance which facilitates this oxidation, must expedite, and therefore improve, the manufacture of vinegar.

We shall have occasion hereafter to comment upon some of the processes which have been devised for promoting the combination of oxygen and alcohol, but at present we deem it better to proceed with a brief description of the old method of making vinegar, and which is still followed in a few parts of this country. If alcohol of itself possessed the power of combining with atmospheric oxygen, the production of acetic acid would be a very simple affair, and perfectly analogous to the slow combustion of phosphorus: but alcohol alone has no great affinity for oxygen at ordinary temperatures, and it is only through the agency of some other substance that this combination can be effected. There are a vast number of substances which enable alcohol to combine with oxygen, and they are said to act "catalytically"; for of themselves they

undergo no change, but merely enable chemical union to take place. The most remarkable of these is platinum in that fine state of division called "platinum black." The effect of this substance is quite surprising; for if it be merely moistened with a few drops of alcohol, and exposed to the air, it instantly begins to evolve copious fumes of acetic acid. Next in activity to platinum black—although very much inferior to it—are the various modifications of animal and vegetable albumen. The latter of these, in fact, is the agent constantly at work in the ordinary operations of the vinegar maker; and this must be borne in mind, in reference both to the old and new methods of acetification. In the old plan, the wort or first liquor is usually made from treacle, though the use of malt for this purpose is largely on the increase. The wort varies in strength, according to the quality of the vinegar desired, and therefore ranges in specific gravity from about 1.055 to 1.085. Such wort may be procured by dissolving from $2\frac{1}{2}$ to $3\frac{1}{2}$ lbs. of treacle in every gallon of water employed; or by mashing with malt or mixed grain, so as to procure at the rate of from 3 to 4 barrels of wort from every quarter of grain. In both cases, the wort, having cooled to the ordinary temperature, is mixed with a little yeast, and run into a fermenting vat; from whence, when the fermentation begins to flag, it is transferred to a series of tubs or barrels, partially filled with the residue of the raisins used by makers of British wine, and called "rape." This rape consists of the skins of the raisins, and the small branchy tendrils of the vine, to which the raisins were attached. The tubs containing rape are worked in pairs, and long rows of them are arranged in compartments, heated to a temperature of 85° to 90° Fahr. In working, one half of these tubs are filled with the fermented fluid, whilst the others are charged only to about one-fourth of their depth. After remaining 48 hours in one set of tubs, the fluid is, in great part, poured out into the other set, which now becomes the full set, and, in its turn, is again emptied, and the fluid transferred to the first: and so on continually, from day to day, for a period of about three months, under favorable circumstances, or six months when a contrary disposition prevails. As soon as the vinegar is considered to be finished, it is "fined" by a solution of isinglass, and fortified by the addition of a little sulphuric acid, which also tends to preserve it.

The great drawback upon the simplicity of this process is, the enormous time required for its completion, and by which a large investment of capital is rendered necessary, to carry on even a very limited concern. To remedy this, Mr. John Ham invented and patented what he calls his "quick vinegar

process"; and so completely has this system revolutionized the art of making vinegar, that three weeks now enable the operator to accomplish with certainty that which he could only hope to do formerly in three months.

The method of Ham consists in pumping a quantity of fermenting fluid, such as malt-wort, over and upon a series of bundles of birch twigs, so as to expose a very large surface to the action of the air,—the temperature of the fluid being meanwhile kept at 90° Fahr. by a coil of pipe, filled with hot water or steam. In this way the warm wort is again brought into minute contact with the oxygen of the air, which it absorbs; and as fast as the vinous fermentation supplies alcohol, this is acidified, and converted into acetic acid: so that the first of these processes is rendered immediately subsidiary to the last, and all loss of alcohol by evaporation prevented. There is, however, a very considerable expense in the continued pumping and re-pumping of the fluid, which diminishes, in some measure, the obvious advantage of this system; and moreover, the quantity of vinegar which escapes in a volatile form, seems much larger than might at first sight be supposed; for the acetic acid, produced in this way, is not nearly equal to the original saccharine strength of the wort: though this loss is said to be less by Ham's method than by the old plan. Improvement is, therefore, still wanted in two directions; first, in reference to a less expensive mode of bringing the oxygen of the air in contact with the fermenting wort; and secondly, in a means of preventing or diminishing the evaporation of the vinegar when formed. Both these indications are fulfilled in the action of the common churn,—provided this instrument be made (as is now usual) in such a way, that the motion is communicated through a central axis or paddle wheel, and not by the revolution of the whole barrel and its contents.

In Germany, the method of Ham has received a modification of which it is not susceptible in this country, from the interference of the Excise regulations. On the continent, it is not wort or a fermented fluid, but dilute alcohol itself which is employed in the production of vinegar. For this purpose, weak spirit, containing about 10 or 11 per cent. of alcohol (and consequently having a specific gravity of about .9840), is employed. This spirit is mixed with a little beer-wort, beet-root juice, or other albuminous matter, and allowed to trickle slowly over a large surface of beech chips contained in a hogs-head, the sides of which are pierced with holes, for the admission of air. By this means, the alcohol undergoes a kind of subdued combustion, and heat is evolved; whilst the acetic

acid, thus formed, finds its way in thin streams to the bottom of the hogshead, and is there collected at an opening left for its escape. It is customary to pass this vinegar once more through the hogshead, to insure the conversion of the whole of the alcohol into acetic acid; but this precaution is superfluous if the current of dilute spirit be well regulated, as we have found from actual experiment, under such circumstances, that not a particle of alcohol remains undecomposed. This method of making vinegar would be extremely economical in this country, but for the excessive duty on alcohol and the restrictive interference of the Excise. For many purposes, such alcoholic vinegar is far superior to that obtained by fermentation, since it contains little or no foreign matter; as an article of domestic consumption, it is, however, not equal to common vinegar, being, in some degree, insipid and destitute of aroma. There is no doubt that, if the industrial genius of Great Britain were not fettered by unwise fiscal regulations, some form of spongy platinum would long ago have been introduced as the catalytic agent for converting alcohol into vinegar. The primary cost of such a substance would form no impediment to its use, for it is indestructible; and the greatest probability exists, that common air, mixed with the vapour of alcohol, or with that of olefiant gas, or even coal-gas, and passed through a tube, containing the above kind of minutely-divided platinum, at a regulated temperature, would furnish an abundant supply of acetic acid. As matters are now arranged, the discoverer of such a process would, however, obtain small benefit by his invention, though he might safely rely upon finding himself engaged in an Exchequer suit, if he attempted to profit by his skill. To so miserable a conclusion has the mediæval fiscal policy of our ancestors reduced us, that if it were possible (and the thing is not improbable) to combine together the elements of water and coal-gas, so as to form alcohol, Great Britain is the only nation in the whole world which could not avail itself of this discovery.

In addition to the methods just described for procuring acetic acid, there is yet another and most important mode, which is based upon the destructive distillation of wood. The acid thus obtained was, at one time, regarded as peculiar; and hence it received the name pyroligneous acid, by which, in its impure state, it is still known in commerce. When most kinds of vegetable matter are subjected, in a close vessel, to the action of a heat verging on ignition, the elements of the vegetable arrange themselves into new combinations; and whilst the greater part of the carbon becomes fixed in the vessel, the oxygen and hydrogen each carry off a portion,

either alone or conjointly; and thus we find, in the volatile products, carbonic oxide and carburetted hydrogen gases, mixed with a hydrogenated substance (pyroxylic spirit) and an oxygenated substance, acetic acid. There are also tar and other highly carburetted products. The best kind of wood or vegetable matter for the formation of this description of vinegar is that of the beech tree or the oak, and these are principally the sorts used by pyroligneous acid makers in this country. The wood to be distilled is first rendered as dry as possible, and then introduced into a large cylindrical vessel or oven; one end of which is furnished with a moveable door, for the convenience of putting in the wood and removing the resulting charcoal; whilst the other end is provided with an exit-pipe, leading to a condenser, in which the tar, pyroligneous acid, and spirit, are condensed and secured. The wood having been properly disposed, a fire is lighted, so as to heat the cylinder or oven red hot; and in this state it is maintained for about 48 hours or longer, according to the size of the charge. The crude liquor from the condenser is then redistilled, and the first portions, which consist of pyroligneous spirit, kept apart from that which makes its appearance afterwards, and is chiefly acetic acid. The quantity of pyroligneous spirit usually obtained is not large, and seldom averages more than one gallon from 8 cwts. of wood. The acetic acid is still very impure, and largely contaminated with tar; hence, when saturated with lime and evaporated to dryness, it has a black color, and is known by the name of "black acetate of lime." Its purification will be described at a future stage; and meanwhile we present a few tabulated results of the general working of different kinds of wood, as illustrating their respective values in the production of acetic acid,—though several of the woods are too scarce and expensive for application to this purpose. The quantity operated upon, in each case, was exactly 8 cwts.; and as the atomic weight of bicarbonate of potash is very nearly double that of acetic acid, no great error will arise if the amount of bicarbonate of potash, in the second column, be divided by two, as the equivalent of acetic acid present in one pound of the crude liquor:—

	286 lbs. gave of crude liquor, in lbs.	1 lb. of which, neutralised, of bicarbonate of potash, in gra.	Gave in all of dark acetate of lime, in lbs.	Gave of Charcoal in lbs.
Apple tree ...	200	610	18	70
Ash	190	792	22	90
Oak	190	815	24	91
Beech	180	960	25	84
Elm	180	800	16	70
Maple	145	640	20	77
Walnut	150	750	15	72
Birch	120	1130	18	70

It will be seen, that the saturating power of the crude liquor bears no uniform proportion to the acetate of lime produced from it,—a circumstance due to the unequal quantities of tar which it contained, and which, remaining mixed with the dark acetate of lime, of course affected its weight. As a general rule, sixteen pounds of wood will yield one pound of the above acetate.

Before entering on the purification of this substance, it may be as well to consider the nature of the changes which take place during the distillation of wood, with a view to discover the most probable means of improvement. We have before stated, that amongst the evolved products, carburetted hydrogen gas makes its appearance; and as this compound differs from acetic acid, chiefly by the absence of oxygen, a hope may be entertained, that the introduction of this element, at a fitting stage of the operation, would oxidize the carburetted hydrogen, and thus convert it into vinegar. In the case of alcohol, two atoms of this substance combine with four atoms of oxygen from the air, and produce one atom of acetic acid and three atoms of water. But for this change to take place, we have shewn that some catalytic agent is needed. Now, if four atoms of light carburetted hydrogen gas could be in the same way catalytically disposed to unite with eight atoms of atmospheric oxygen, then one atom of acetic acid and five atoms of water might result; and the admission of air, during the process of distillation, in quantity proportioned to the demand, is by no means an unlikely method of effecting the desired object. The instrument now so much used in gas works, and called an "exhauster," offers a ready means of drawing in any amount of atmospheric air during the continuance of the process; and, with common caution, there could be no risk worth mentioning in its employment.

It does not admit of doubt that the greater portion of the non-condensable matter evolved during the destructive distillation of wood, possesses all the elementary principles of acetic acid, with the exception of a proper dose of oxygen; and it can be proved, by direct experiment, that when wood is distilled in contact with peroxide of manganese, a much larger quantity of acetic acid is produced than when no manganese is used. At the same time the amount of non-condensable matter is sensibly diminished; thus tending to prove that the light carburetted hydrogen may be oxidized like alcohol, and converted into acetic acid, as we have suggested. Indeed it is a notorious fact, if coal-gas be burnt imperfectly—as happens when the access of air is insufficient for the complete combustion of the gas—that both aldehyde and acetic acid are

found; and it is to the former of these that the peculiar odour is due, which becomes sensible under such circumstances. It seems to us, therefore, that too much interest can scarcely be attached to the importance of oxidizing the non-condensable products evolved from wood during its distillation; as by this means substances which now escape into the air and contaminate it, will become highly valuable commodities.

To give an idea of the relative amounts of acetic acid and non-condensable matter given off from wood by the present unscientific method, we subjoin the following table of experimental results from ten different kinds of wood, by which the enormous loss sustained under the head, non-condensable or gaseous products, will become apparent:—

Quantity of wood employed, 84 lbs.	Charcoal produced, lbs.	Crude liquor, lbs.	Non-condensable matters, lbs.	Real acetic acid lbs.
Beech	24	46	14	3·06
Young oak	28	39	14	3·06
Hawthorn	20	27	37	3·73
Ash	23	48	13	2·45
Old beech	20	47	17	2·40
Elm	21½	45½	17	2·26
Liburnum	20	46	18	2·00
Alder	20	48	16	1·86
Birch	23½	45	15½	1·86
Willow	18	49	17	0·77

So that, as a general rule, the gaseous matter stands to the acetic acid produced, in the ratio of about 5 to 1; and this vast loss is almost entirely due to a want of oxygen sufficient to oxidize the peculiar form of hydrocarbon which constitutes the basis of acetic acid. Let us hope that those practically engaged in this department of manufacturing industry, will turn their attention to the probability of discovering some cheap and simple means through which this waste may be prevented. Reasoning by analogy, there is a strong presumption that atmospheric air may be made to answer the desired end.

We have previously alluded to the fact, that the acetate of lime which is formed from the destructive distillation of wood, is largely contaminated with tar, and other pyrogenous impurities, which require to be removed ere it is fit for any but the rudest purposes. There are at present two different modes of operating with this view, though, in reality, they both arrive at the same result by the same means. In those places where acetate of lime is formed in the first instance, this is subsequently decomposed by sulphate of soda, so as to produce an insoluble sulphate of lime, and a soluble acetate of soda; the latter of which, being separated from the former by filtration, is evaporated to dryness, and then assumes the

character of that, which, by the other mode of operating, is made at once: that is to say,—the second plan consists in decomposing crude hydrosulphate of soda by means of the impure acetic acid of a double distillation,—so that sulphuretted hydrogen gas is evolved, and acetate of soda formed; which latter, on being evaporated to dryness, resembles exactly that obtained from the acetate of lime, as before stated. In either way an impure acetate of soda is formed; and, as it is a feature in the nature of this salt that it may be heated almost to redness without decomposition, the tar, and other carbonaceous matters, are, so to say, burnt off at a temperature of about 400° Fahr., whilst the acetate of soda remains unchanged; and, by solution in water, filtration, and subsequent crystallization, may be had extremely pure. This roasting process is conducted in a peculiar kind of oven, into which a current of air passes; and the workman judges of the success of the process by removing small samples, from time to time, and dissolving them in water. If the solution is seen to be colorless, the decomposition of the tarry matter is known to be complete.

Having in this way obtained a sufficiently pure acetate of soda, the production of pure acetic acid is an easy operation, for it suffices to mix this acetate, in a proper distillatory vessel, with a due amount of sulphuric acid, and to apply heat, when the acetic acid passes into the condenser, and an acidulous sulphate of soda remains in the vessel. This sulphate may be either decomposed by charcoal at a red heat into sulphuret of sodium, or employed to decompose impure acetate of lime for a subsequent operation. There is an advantage in decomposing acetate of soda, which does not exist in acetate of lime; and that is dependent upon the fact, that any excess of sulphuric acid, in the former instance, merely combines with the soda to form an acidulous sulphate of soda; whereas, with lime, the excess of sulphuric acid remains free, and, by re-acting on the acetic acid liberated, not only destroys it, but moreover contaminates the distilled product with sulphurous acid, and renders it necessary to re-distil the acetic acid from a vessel containing peroxide of manganese, or lead. There are, however, many other modes of decomposing acetate of soda, which would yield a more uniformly pure product than by the use of sulphuric acid. Thus, for instance, boracic acid might be employed, and the residuary salt made into borax; or the acetate of potash might be decomposed by oxalic acid, and the resulting oxalate converted into binoxalate of potash or salt of sorrel. On this point it is needless to enumerate illustrations; for as the object in

view should be, the production of pure acetic acid, simultaneously with that of a marketable residuum, there can be no difficulty, with any practical manufacturer, to adapt his process to the wants of his immediate neighbourhood.

As regards the pyroxylic spirit or wood naphtha, together with the tar which results from the distillation of wood in this way, there need not much be said, nor is it exactly connected with our subject: nevertheless, a trifling improvement is wanted in the treatment of these vegetable tars. The wood naphtha, being an extremely volatile substance, requires nothing more than careful distillation to free it from every impurity; but this should not be carried so far as to render it perfectly miscible with water, for in this state it is not a good solvent of shell-lac; for the solution of which it is much used by hat manufacturers. The presence of a little acetone is necessary to communicate this property; and therefore, where wood naphtha has been too highly rectified, about 5 per cent. of acetone must be added, to fit it for the wants of the hat-maker.

The operations now carried on under the patent of Mr. Young, shew that tar will yield both paraffine and a variety of heavy oils, well adapted for machinery; and therefore it behoves the makers of pyroligneous acid to ascertain, by practical experiments, how far the discoveries of Richenbach may be brought out in a commercial bearing. Eupione, paraffine, and, lastly, pittacal, should all be sought for in a manufacturing spirit; for it is evident that the hitherto worthless oils may find a ready market as lubricants for heavy machinery, and thus complete the entire circle of the manufacture of pyroligneous acid and its products.

The Manufacture of White Lead.

One of the most important uses to which acetic acid is applied in the arts, is that of manufacturing white-lead. This process, though doubtless susceptible of some improvement, seems nevertheless incapable of any very great alteration, though there is not perhaps a single subject which has more extensively occupied the skill and labor of inventors. Patents for improvements in the manufacture of white-lead are, in fact, almost as "plentiful as blackberries;" but we have yet to learn, that even a moderate degree of success has attended the best of these schemes. In truth, the greatest ignorance has prevailed, and in some measure still prevails, respecting the composition of white-lead; and it is precisely in conse-

quence of this ignorance, that many have patented processes for the making of white-lead, though the processes in question would not make white-lead at all. The mistake has arisen from regarding the well-known pigment as carbonate of lead, which, in one sense, it certainly is. But it is not a neutral carbonate; and herein lies a great distinction. White-lead, when properly prepared, is a hydrated basic carbonate of lead, and consists of one atom of hydrated oxide of lead united to two atoms of neutral carbonate of lead; and it is the presence of the atom of hydrated oxide which confers on this compound its peculiar qualities as a pigment when mixed with oil. The resulting mass becomes, in fact, a kind of imperfect soap or plaster, containing opaque particles of carbonate of lead, everywhere disseminated throughout the oily mixture. It is, in short, a chemical combination; whereas, when carbonate of lead alone is used, the result is but a mechanical mixture, in which there is no more union between the metallic salt and the oil than happens in the case of sulphate of baryta. The consequence is, that such pigments work thin and want body, or, in the technical language of the painter, they do not "cover" well. This want of covering power has been the great stumbling block upon which every successive project for the making of white-lead has broken down; and, as the true cause of failure was quite unknown to the various projectors, it may readily be conceived that the schemes occasionally were not less remarkable for absurdity of design than for difficulty of execution. Blinded by the prevailing error, that white-lead and carbonate of lead were identical, there seemed to inventors but one problem to solve, and that a very simple one, viz., how can carbonate of lead be made most economically? The value of the article, when obtained, was never called in question,—and the terms white-lead and carbonate of lead were invariably regarded as convertible and synonymous. All manners and modes of procuring carbonate of lead have therefore been patented, and the changes upon chemical composition and decomposition have been rung over and over again, till the very echo tired by repetition, in order that no possible source for preparing this metallic carbonate might escape the restrictive operation of the Great Seal. But all this while no one thought of asking, will carbonate of lead answer the purpose? It was the old story of the "live salmon and the bucket of water," but without the practical experiment which demonstrated the folly of further research. And now we know that a vast number of patents exist for the manufacture of carbonate of lead, by not one of which can an atom of white-lead be produced. It is time

therefore that inventors should learn the real difference between these articles; for, without such knowledge, improvement is almost impossible, and can never rise beyond the grade of a lottery. We have done our best to point out the constitution of these bodies, and to explain the cause of their great dissimilarity;—the means of converting one into the other must come from some other quarter. The road to improvement, however, is open, if genius and industry are willing to pursue it.

The manufacture of white-lead, properly so called, is one, the nature of which is yet enveloped in obscurity. So far as appearances go, the action would seem to consist,—first, in the oxidation of metallic lead by the atmosphere, under the influence of the vapour of acetic acid; secondly, in the production of acetate of lead, by the combination of the oxide of lead with the acetic acid; and, thirdly, in the displacement of the acetic acid from its union with the oxide of lead, by the action of carbonic acid, and the consequent formation of white-lead. But this in no way accounts for the fact, that, when acetate of lead is decomposed by carbonic acid, it is carbonate of lead, and not white-lead, which is formed. Nor can we conceive how an acid like the acetic is capable of being wholly expelled from a metallic oxide by a quantity of another acid incapable of completely saturating that oxide. In other words, as white-lead contains free or uncombined oxide of lead, how happens it that the free acetic acid does not remain united to this? We confess our inability to reconcile the facts of the case with the preceding hypothesis, and therefore pass on to another, in which we will assume that acetate of lead, but not the neutral acetate, is formed as we have already supposed. Now there are two subacetates;—one composed of six atoms of oxide of lead to one atom of acetic acid; and the other consisting of three atoms of oxide of lead to one of acetic acid. We select, in preference, the former, as it is the one which forms naturally when acetic acid acts, at common temperatures, on an excess of oxide of lead. The composition of this salt is such, that, if we can conceive slow combustion to take place, or that its acetic acid combining with the oxygen of the air is resolved into water and carbonic acid, then the carbonic acid produced would be exactly sufficient to saturate four atoms of the oxide of lead, and leave a compound of the precise composition of white-lead. On this view, the first action in a white-lead stack would be the production of sex-basic acetate of lead; and the next would be the destruction of this by eremacausis, and the formation of white-lead.

The apparatus employed in the manufacture of white-lead is extremely simple, and consists merely of certain large enclosures or spaces, called beds, in which the stacks are built up; together with the earthenware pots needed for holding the vinegar, and the machinery used in casting the lead, and grinding the white-lead, so as to fit it for the market. The metallic lead was formerly used in the shape of sheets or coils, which were placed perpendicularly over the vinegar pots; but this practice has been almost everywhere abandoned, and at present the lead is generally cast into what are called "crates" or "grates," of about nine inches square, and having the appearance of lattice-work; the object being to expose as large a surface as possible of metallic lead to the action of the vapour of the vinegar. The beds are of considerable size; and, in this respect, some diversity of opinion prevails amongst practical men; but it seems pretty certain that no advantage is gained when the area of a bed comes to exceed 300 square feet; and there are many reasons for believing, that, with beds of twice this area, the gain, in point of diminished labour, is much more than compensated for by the reduced produce in white-lead. Nevertheless, each manufacturer seems to entertain an opinion of his own in respect to this matter; and there are even some pretensions to secrecy concerning it. In fact, everything depends upon the construction of the bed, for it is this which regulates the production of white-lead; and, as a proof of the great importance connected with this circumstance, we may here mention, that, whilst one manufacturer has produced as much as 65 per cent. of corrosion during a long course of years, another in his immediate neighbourhood has never been able to exceed 52 per cent. The beds of the former are 16 feet square, whilst those of the latter are $19\frac{1}{2}$ feet square; and, in dwelling upon the details of this operation, we shall find that, theoretically, a bed may be too large, as the above practical fact indicates. Similarly, it can be shewn, that a stack (which is merely a series of beds) may be too large; and experience has convinced us that a stack containing more than eight beds is to be condemned; and, as a general rule, six should be preferred, except where want of space renders a different line of manufacture indispensable.

In forming a stack, it is necessary to begin by laying, in the first instance, a bed of spent tanner's bark, three feet in thickness, over the surface of the bed; and upon this are placed the earthenware pots containing the vinegar. These are arranged, side by side, and filled to about one-third of

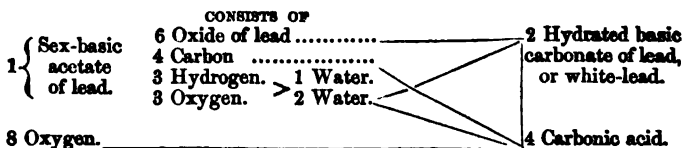
their contents with vinegar, of a strength equal to six per cent. of anhydrous acetic acid. Upon these pots are placed the crates of lead, and over all a series of boards are arranged, which form a floor for the next layer of spent tan. Such an arrangement, as we have described, is denominated "a bed," but there is this difference between the beds, viz., that the lowest or bottom bed has a bed of tan three feet in thickness, whereas but one foot is needed in the others. Having finished the lowest bed, 12 inches of spent tan are now placed upon the boards, and a similar arrangement of pots, crates, and boards, takes place, which constitutes the second bed; this is followed by a third, a fourth, and so on, until at last the uppermost bed is finished; when a layer of spent tan, 30 inches in thickness, is placed over the whole, and the operation may be said to commence. In six or eight days the tan begins to ferment and evolve heat; and this goes on increasing for some weeks, when it gradually diminishes, and at the end of about three months the whole has become cool, and the stack is fit to be taken down. When examined, the pots, which formerly contained vinegar, will now be found to be quite empty, or to hold a little water merely, but no acetic acid; the leaden crates will be discovered to have increased sensibly in bulk, to have become coated with a thick and dense incrustation of white-lead, and, in some places, even to have become altogether converted into this substance; whilst the tan, having lost its fermentative quality, is now useless, except as fuel.

The successive beds, constituting the entire stack, are next carefully removed, so as to obtain the white-lead with the least possible admixture of tan; and as a portion of the substance always adheres to the crates, these are washed in a kind of wear or trough, by which the whole of the tan is thoroughly separated. When this is seen to be complete, the corroded part of the crate or "white-lead" is detached from the uncorroded or "blue-lead," by means of slight taps or blows with a mallet. The blue-lead is weighed, and, for the most part, re-melted and again cast into crates; whilst the white-lead is first crushed, and afterwards ground in water into a fine powder, when it is collected by elutriation and deposition, and dried in stoves, a little below the boiling heat of water. Formerly this grinding was performed in the dry way, and much injury to the health of the workmen thus resulted; but, during the last twenty years, the wet mode of grinding has become general, and is greatly to be preferred.

The conversion of white-lead into paint is a simple mecha-

nical operation, though, as we have before remarked, it is followed by chemical results; for there can be no doubt that the surplus oxide in the white-lead combines with part of the oil employed to form the paint, and gives rise to a true plaster or metallic soap. The proportions of oil and white-lead vary with different manufacturers; nor does it much matter what these proportions are: the principal point is to obtain a thorough intermixture of the two ingredients; and this is done by grinding them together beneath heavy stones or "runners," for several hours, at the end of which time the mixture will be found homogeneous.

If we examine the process of white-lead making with a view to discover its chemical peculiarities, we perceive at once that it presents no salient feature to guide our enquiry. The most probable explanation is certainly that before given, and which supposes the pre-existence of sex-basic acetate of lead. At the same time, there are no experiments which prove that this substance is capable of undergoing the slow combustion requisite to complete the argument. But then this is precisely the question which now calls for solution; and there are many analogous facts in chemistry that warrant the kind of cremacausis or combustion here hinted at. And presuming this to be correct, then one atom of the sex-basic acetate of lead and eight atoms of atmospheric oxygen, would unite as in the following diagram, and produce two atoms of white lead, and three atoms of water, two atoms of which would remain united to the white-lead thus:—



It remains, however, to be demonstrated, whether this kind of subacetate of lead, and which is readily formed by boiling acetic acid with a large excess of litharge, can, under the influence of a gentle heat, become thus converted into white-lead.

Connected with this subject, is the fabrication of an article called the subchloride of lead, or oxychloride, which is now coming into use as a substitute for white-lead. The oxychloride is so constituted that, if, for two atoms of carbonate of lead in white-lead, we substitute two atoms of chloride of lead, the result will be the new compound, and which has been made the subject of a patent by Mr. H. Pattinson, of

Newcastle-upon-Tyne. Now it is a very remarkable fact, and strongly corroborative of the views which we have here advanced, that the new paint "covers" equally well with the best white-lead, just as its basic composition would indicate; and the probability is, that the oxide of lead contained in it unites to part of the oil of the paint, forming, as before, a metallic soap; whilst the chloride of lead remains interspersed in the mass, and communicates opacity and whiteness. An observation, made, we believe, in the first instance, by Dr. Ure, shews the correctness of such a conclusion; for, though, when alone, the oxychloride of lead be quite insoluble in water, yet, after admixture with oil, boiling water readily dissolves from the mass the chloride of lead, and leaves the oxide combined with the oil. This circumstance, which can be easily demonstrated, seems also to shew, that paint, made with an insoluble salt, like carbonate of lead, is preferable to one made with a soluble salt, like the chloride. Experience, however, alone can decide the correctness of this assertion.

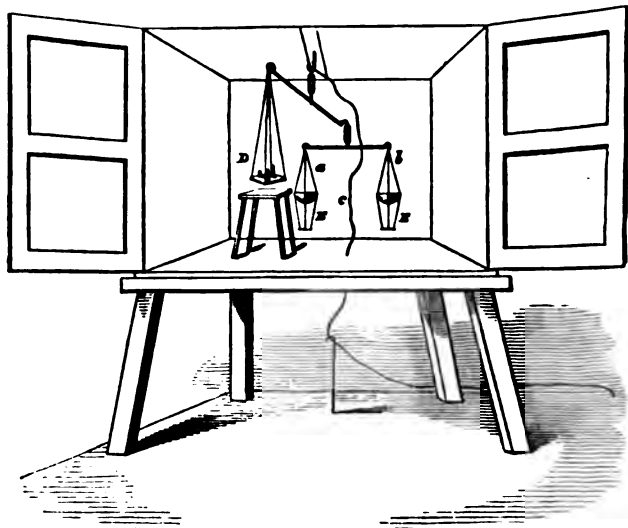
*Electrical condition, in its relation to Heat, Meteorology,
Epidemic Diseases, Ventilation, &c.*

BY FRANKLIN COXWORTHY, ESQ.

ELECTRICITY being now the admitted active agent in all natural phenomena, any detail of well systematized facts cannot fail in proving of much interest to the enquiring portion of society. I am therefore induced to present, in a condensed form, results that have been afforded by an apparatus I have had in operation since 1845,—leaving it to the reader to form his own opinion of their value in reference to the subject that may more especially engage his attention, whether in connection with the animal and vegetable kingdoms, or physical science in general.

Before, however, proceeding to a detail of these facts, I should premise that the result of an investigation, which I instituted about twenty years since, on organic chemistry, and subsequent enquiry, imparted to my mind an impression that the atmosphere in which we move was at all times electrically positive to the earth; and that opinion being adverse to the then generally received doctrine in the scientific world, of the earth being positive to the air, on the principle of evaporation being induced by electricity, the apparatus, illustrated by the following diagram, was devised, to put the question to the test of experiment. The apparatus was placed on the north side

of a brick wall, where it was protected from the influence of sun, wind, and rain ; and, further to secure it from draughts, it was enclosed in a common meat safe, the panels of which were formed of stout gauze, to ensure the same degree of temperature within the safe as in the open air.



Two copper vessels of $7\frac{1}{2}$ inches in diameter, capable of containing about a quart of water each, were suspended from a scale-beam,—the one *a*, by silk, and the other *b*, by fine copper wire. To an iron hook, which sustained a second beam, from which the first was pendent, a stout copper wire *c*, was connected, and this again was attached to an iron rod, driven four feet into the ground. In order to ensure full terrestrial influence, this copper wire was conducted several feet under ground, in connection with a wall. To the copper vessels, containing the water to be evaporated, were appended small dishes *E*, for the restoration of balance, by adding weights to the lightest : which weights determined the amount of differences ; and the total amount of evaporation from both vessels was readily ascertained by taking off weights from the flat scale *D*, of the beam which carries the beam of the evaporating vessels *a*, *b*, until the balance was restored.

The nature of the information afforded by this apparatus is shewn by the two following statements, compiled from daily observations at 9 A. M., 5 and 10 P. M., from 1846 to 1851, inclusive :—

DIFFERENCES OF EVAPORATION FROM *a* AND *b*.

DATE.	1845.		1846.		1847.		1848.		1849.		1850.		1851.	
	Insulate.	Non-Insul.	Insulate.	Non-Insul.	Insulate.	Non-Insul.	Insulate.	Non-Insul.	Insulate.	Non-Insul.	Insulate.	Non-Insul.	Insulate.	Non-Insul.
January ..	The vessels were first filled on Oct. 10th, 1846.	..	..	270	115	140	40	325	170	90	65	265	395	10
February ..		..	..	70	280	105	100	55	125	155	95	200	95	..
March		..	365	33	370	130	145	170	175	200	65	340	245	60
April		..	215	75	195	195	60	295	20	515	235	320	145	20
May		..	340	345	225	185	240	275	60	695	90	365	165	55
June		..	445	460	200	175	425	145	65	660	225	375	290	65
July		..	900	100	215	225	335	175	455	235	690	65	280	30
August		..	245	35	355	65	340	65	295	150	160	70	180	65
September ..		..	225	120	345	65	105	180	65	205	50	180	..	180
October		..	280	144	150	275	310	145	130	280	165	40	110	30
November ..		960	..	130	195	90	290	140	95	80	405	315	..	20
December ..		..	245	135	80	320	160	150	110	325	185	..	125	..
Grains ..	960	..	3360	1983	2620	2170	2400	2075	1720	3915	2340	2130	2050	545
Mort. & Cl.	2-379	..	2-379	..	2-782	..	2-662	..	3-113	..	2-176	..	..	..

TOTAL EVAPORATION FROM *a* AND *b*.

DATE.	1846.	1847.	1848.	1849.	1850.	1851.
January	3360	3720	7680	9120	3240	4125
February	6240	5240	9000	9600	4200	2995
March	10080	9480	10560	8640	5040	5285
April	14400	14400	11040	13440	6240	5970
May	22560	22540	29860	15360	9600	10625
June	32160	23040	21120	24960	15840	15075
July	29280	24960	24000	24960	14880	12895
August	17280	24480	17760	22560	11515	13530
September ..	16120	19680	14160	13360	9460	9570
October	8160	12000	12480	12200	5730	5985
November ..	6240	9600	12640	10000	5010	3380
December ..	3360	8640	7680	7500	1385	2640
Grains	168240	177780	178580	171700	92140	92075

It will be seen then, on reference to the totals of differences of 1846 and 1849, the commencement and termination of the epidemic period, that during the potato disease in 1846, the numbers are 3360 and 1983; whilst, in 1849, when this scourge disappeared and cholera depopulated the land, the figures are reversed, being 1720 and 3915; and as the following evidence will shew that evaporation is not referable to "heat," it may reasonably be inferred, as electricity induces evaporation, that in 1846, the negative state of the earth retarded the evaporation in *b*; whilst in 1849, immediately opposite conditions, both in the air and earth, produced contrary effects.

It will be observed also, by the total evaporation, that the

electrical influence, whether from disturbing or other causes, was much greater throughout the epidemic period than in subsequent years; which places us in possession of the highly interesting fact, that these differences have no connection whatever with actual evaporation; since those of 1850, with little more than half the amount of the epidemic period, are equal in amount to those of 1848, the greatest total evaporation, viz., 4470 and 4475; whilst, with a corresponding evaporation in 1851, the differences are only half of those of 1850.

I have identified electricity with cold instead of with heat, and it is an established fact that combustion during frost is much more active than in hot weather,—the rays of the sun actually put a fire out. The electrical condition of 1846 could not fail therefore in maintaining the heat or negative state of the system, and in conducing to the healthy or putrefactive process of digestion; but when the atmosphere became negative and the earth positive, the body became cold and electric, and watery discharges superseded those of putrefaction: conditions, however, highly calculated to restore to the non-nitrogenous portion of the vegetable kingdom that healthy action which it lost in 1846.

The next fact, in relative importance, which this apparatus has elicited, is that evaporation is not referable to heat,—it being unquestionable that decrease of temperature in the atmosphere, although not invariably, but as a rule, produces increase of evaporation,—whilst a contrary change produces corresponding results. The truth of this may readily be ascertained by the evaporation of water from one vessel of a pair of scales,—weights being placed in the other; but where time or inclination preclude such a test, the following table may be received in evidence,—it being observed, that in December, 1850, the proportion was only 1 to 173:—

RELATION OF TEMPERATURE TO EVAPORATION FOR 1851.

	Mean Temperature.	Reduced Scale.	Evap. Grains.	
January	43	11	4,125	or 1 to 357
February	39	7	2,995	" 428
March	42	19	5,285	" 528
April	46	14	5,970	" 426
May	53	21	10,625	" 506
June	62	30	15,075	" 502
July	64	32	12,895	" 403
August	63	31	13,530	" 437
September	58	26	9,570	" 368
October	54	22	5,985	" 272
November	38	6	3,380	" 563
December	41	9	2,640	" 293
Year	50	18	7,673	425

The above mean temperatures are deduced from my register of 9 A. M.,—the reduced scale consisting merely of a deduction of 82° ; that being, improperly, our freezing point, instead of zero; and it must be evident that, in any such comparison as the above, the addition of 82° to 6° , the proper temperature of November, or to 82° , that of July, could not fail in creating a serious error. Between the figures in the reduced scale and the actual evaporation there is, it will be observed, no relation whatever.

Evaporation not being referable to heat, it is evident that the hygrometer, which is based on that doctrine, must be faulty in its results. To determine this, I have tested the instrument against actual evaporation, regularly for the last two years, and have found it alike wanting at all times of the year and under all circumstances. As the most favorable results obtained, I annex an extract from my register for February, 1852, shewing the mean of difference in wet and dry bulbs of hygrometer; and the total evaporation and mean of temperature, as registered at 9 A. M., 5 and 10 P. M.:—

February, 1852.	Mean of Hygrometer.			Total Evaporation, grains.			Mean of Temperature.		
	9	5	10	9	5	10	9	5	10
1	1.	1.5	2.	50	150	60	51	52	50
2	1.	1.	1.5	—	90	40	49	50	50
3	1.5	2.5	2.	100	70	60	46	44.5	44
4	1.	1.	1.5	40	10	70	42.5	46.5	50
5	2.	1.5	1.	120	60	30	52.5	53.5	53
6	2.	2.5	2.	160	110	40	50	46	43.5
7	1.	.	.	60	.	80	39.5	.	.
8	1.5	1.	1.	40	75	15	48.5	50	50
9	1.	1.	1.	100	90	50	46	42	38.5
10	1.	1.5	2.5	30	75	50	36	39	40
11	1.5	1.5	1.5	40	20	30	36	36.5	37.5
12	1.	1.5	1.5	40	30	30	33	34.5	36
13	1.	1.5	1.5	60	50	30	34	36	37.5
14	1.	1.	1.	40	30	—	37	39	39.5
15	.5	.5	.5	30	15	25	38.5	42.5	45.5
16	.5	1.5	1.5	70	70	30	43	43.5	46

The hygrometer, I should observe, since the 1st of February, has been kept in the safe with my scales; still a reference to the 2nd, 3rd, and 9th of the month, when the temperatures were much the same, will shew a deplorable deficiency; and on two days, when there was no evaporation, a difference prevailed between the wet and dry bulbs.

Mr. Andrew Crosse, about thirty years since, shewed, with his exploring wires, that the upper or surrounding regions are,

* Did not register at 5 P. M.

at all times, highly electric; and the late Mr. Henry Weekes demonstrated, about twenty years ago, with his electric kites, that the condition decreases with decreased distance from the earth; whilst the above detailed facts leave no room for doubt, that the relative electrical condition of the air and the earth, from causes that have yet to be defined, is of a fluctuating nature; although the influence of the air is greater than that of the earth,—the total of differences from 1846 to 1849, inclusive, being 14,490 and 12,818. Electricity I have identified with cold, and the atmosphere increases in cold with increase in electrical condition; and we are informed by Professor Faraday that “oxygen is the least diamagnetic of the gases,—nitrogen one of the most; in common with solid bodies, the gases are rendered more diamagnetic by increase of temperature (an ascending influence), and *vice versa*.” Bodies, similarly electric, repel each other; and those gases that are diamagnetic are of less specific gravity than air, or are attracted to the upper regions, whilst oxygen is drawn or repelled to the earth,—oxygen being evolved by the vegetable kingdom in conjunction with electricity. Electricity is the bond in matter, the attraction of cohesion; and matter becomes electric by compression and contraction. The fact that matter increases in weight, as well as specific gravity, by compression and contraction, still remains without scientific acknowledgment or controversion, although made public so far back as 1849.

FOREST COTTAGE, MAREFIELD, SUMMER,
April 5th, 1852.

INSTITUTION OF CIVIL ENGINEERS.

March 23rd, 1852.

The first paper read was, “*On the results of the use of tubular boilers, or of flue boilers of inadequate surface, or imperfect absorption of heat.*” By ADMIRAL EARL DUNDONALD.

This paper advocated the general introduction of what were termed “economical heat trap boilers,” or boilers having vertical water tubes instead of oblique fire tubes, contained within a chamber, into the upper part of which the hot products of combustion were introduced, and allowed to circulate, until, by the abstraction of heat, they descended to the bottom, and passed into the chimney at a temperature little exceeding that of boiling

water. From some trials which had been made at Woolwich and Chatham in 1844, as well as from the experience which had been gained by their actual application to some of the North American transatlantic steam packets, and some in the service of the Emperor of Russia, it was contended that these boilers possessed greater evaporative powers, and were more economical than those ordinarily in use; and, moreover, that their safety was much greater, owing to the products of combustion passing into the chimney at a very low temperature, instead of the usual high temperature, from which it was apprehended much danger had been, and might still be incurred.

The second paper read was "*On certain points in the construction of marine boilers.*" By Mr. J. SCOTT RUSSELL, M. Inst. C.E.

The author having arrived at certain practical results relative to the construction of marine boilers, put them into practice about ten years back, in designing the boilers for the Royal Mail steam packets Clyde, Tay, Tweed, and Teviot; and as they had been in constant work ever since, running from 42,000 miles to 48,000 miles per annum, without material repairs, he believed their durability, combined with effective combustion and economy of fuel, had been fully established.

The principles on which these boilers were constructed differed from those generally recognized. In the first place it was considered that a judicious distribution of the most intensely heated surfaces would be conducive to durability; and for this purpose, instead of returning the flues over the furnaces, the top of the furnaces and the hottest flues were brought to the surface of the water, and the cooler or return flues were taken to the bottom of the water. The water was admitted at the bottom and was gradually warmed as it rose,—the greatest heat being imparted at the last moment: by which means the bubbles of steam were prevented from accumulating in contact with intensely heated metal. In the next place, the capacity of the furnaces, or fire boxes, was unusually large, and their height above the incandescent fuel much greater than usual. The evaporating surface in these boilers was also much more than customary,—there being no less than three feet of evaporating surface for every foot of furnace bars. The process of blowing off was provided for by arranging under the flues and furnaces large water spaces, as reservoirs for the collection and blowing-off of brine and other deposit.

The last paper was, "*A description of a diaphragm steam generator.*" By M. BOUTIGNY (d'Évreux).

The principle upon which this steam generator was based was, that "bodies evaporate only from their surfaces." This being received as an axiom, it must necessarily follow that, in the construction of steam boilers, either the evaporating surface of metal

should be extended to its utmost limit, or the water should be so divided, and its evaporating surfaces be so multiplied, as to arrive at the same end—of obtaining the greatest amount of steam by the expenditure of the least amount of fuel.

The steam generator was described to consist of a vertical cylinder of wrought iron, 25 inches high by 12 $\frac{1}{2}$ inches diameter; the base terminating in a hemispherical end, and the upper part closed by a curved lid, upon which was attached the usual steam and safety valves, feed, steam, and other pipes, &c. The interior contained a series of diaphragms of wrought iron, pierced with a number of fine holes, and having alternately convex and concave surfaces. They were suspended by three iron rods, at given distances apart, in such a manner as not to be in contact with the heated exterior or shell of the boiler. When any water was admitted through the feed-pipe, it fell upon the upper (convex) disc, which had a tendency to spread it to the periphery,—the largest quantity falling through the perforations in the shape of globules; the second diaphragm being concave, tended to direct the fluid from the circumference to the centre; and so on, until, if any fluid reached the bottom of the cylinder, it mingled with a thin film of water, in a high state of ebullition,—that being the hottest part of the boiler. It appeared, however, that, in its transit through these diaphragms, the water was so divided, that, exposing a very large surface to the caloric, it was transformed into steam with great rapidity, and with great economy of fuel. The boiler described had been worked for a long time at Paris with great success, giving motion to a steam-engine of two horses' power. The consumption of coal was stated to be very small, 789 lbs. of water having been converted into steam by 182 lbs. of coal, in nine hours, under a pressure of ten atmospheres.

The practical application on a large scale was submitted to the engineers, the author having only proposed the system for small boilers and under circumstances where a motive power was required in a restricted space, and where first cost was a great object.

March 30th, 1852.

The paper read was, "*An account of the drainage of the town of Richmond, Surrey, under the authority of the Metropolitan Commissioners of Sewers, in 1851.*" By Mr. GEORGE DONALDSON, Assoc. Inst. C.E.

The drainage of Richmond, extending over an area of about 320 acres, was undertaken by the Board in the year 1849, on the application of some of the principal inhabitants; when the author was appointed to report on its then state, and to propose some general plan for its improvement. At that period, all the sewage was collected into cesspools, the liquid contents of which were allowed to drain into the earth, causing offensive exhalations from

its surface, and contaminating the water in the adjacent wells, from which a large portion of the house water-supply was drawn, whilst the cesspools themselves were seldom emptied. In many of the streets, however, there were brick drains, which had been from time to time constructed for carrying off the surface and storm-waters; but these were not deep enough to receive the house drainage, which it was determined to effect by means of tubular stoneware pipes, entirely independent of, and separate from, the brick drains,—thus practically carrying out a system on which very different opinions had been entertained. At present the outfall of the sewerage was into the Thames, near the railway bridge; but eventually a main outfall-sewer was to be constructed to connect Richmond with the general system of sewerage of the metropolis. The pipe sewers were about 50,000 feet in length, executed at a cost of about £7,500,—rather more than half consisting of minor or branch sewers. The branch pipes, as far as the kerb of the foot-pavement, were laid down at the same time as the main pipes,—each junction being formed at an acute angle, and so arranged as to receive the drainage of three houses. Before being laid in the trenches, the pipes were fitted together and marked, and afterwards packed solidly round with earth. In some of the wet sand-beds it was considered advisable to lay the pipes on 2-inch deals, four inches deep, fastened to stakes. The joints were made with well-tempered clay and cement; and it was very important that they should be water-tight; for otherwise one of the chief advantages of pipe sewers over brick drains would be lost. After their completion, the pipes were proved, by allowing a flush of water to pass through each separately for about fifteen or twenty minutes. All the inlets to the house drains were trapped with syphons or bell-traps; and the works generally had been perfectly successful.

In the discussion which ensued, the comparative merits of the systems of separating the storm-water from the house sewerage, and of combining them in large sewers, were argued at great length. It was admitted, that the separate system had not yet been tried for a sufficient length of time to arrive at definite results; but, as far as experience had hitherto gone, there was a general impression in favor of the combined system in main sewers of brick, not less than four feet high, in order, not only that men should pass easily up them, but that they should be able to work in them. The pipe drains, even of 21 to 24 inches diameter, were liable to be choked by deposit; and their areas had been so reduced, even where the separate system had been employed, that stoppages had continually occurred;—thus proving that the exclusion of road-drift was not entirely efficacious. It was shewn also, that whenever it was necessary to cut into the pipe drains, there was great injury from breakage, and they were ultimately more expensive than brick drains.

April 6th.

The discussion on MR. GEORGE DONALDSON'S paper, on the "*Drainage of Richmond*," occupied the whole evening.

The system of pipe sewers and house drains of small area, as compared with that of main brick sewers of considerable area, with pipe house drains as feeders, was fully discussed; and it was shewn that the latter system was much to be preferred, inasmuch as the small area of the newly-introduced pipe sewers rendered them incapable of carrying off the sewerage,—that they very frequently became stopped up by accumulated matter from the houses,—that when this occurred, as their dimensions prevented a man from passing through them, great expense was incurred in breaking up the streets, the pipes were broken to a great extent, and at hazard, in seeking for the stoppage,—and that even the weight of the earth, in sinking, frequently destroyed these pipes. The system of back drainage, through different private properties, was objected to. Brick drains, above fifteen inches in diameter, were shewn to be less expensive than pipes of the same area, and their durability to be much greater. It was stated that, in spite of constant streams of water through the pipe drains, it was not possible to keep them free from accumulations, caused by grease, hair, and other extraneous matters, even at Richmond, which was perhaps as favorable a locality for the trial as could have been found. The removal of the stoppages frequently cost as much as the original laying of the pipe drains, in consequence of the liability to aggregation in them, as already stated. The street sewers should, in general, and especially where the declivity was small, and the depth under ground considerable, be of sufficient dimensions to allow a man to pass up easily, to discover and remove obstructions.

With respect to the alleged advantage of the diminished friction, from the smooth interior surface of the pipe drains, it was shewn, that considerable misapprehension existed on that part of the subject; for that, in point of fact, fluid friction was not dependent upon the so-called smoothness of the surface, and was practically the same in a rough cast-iron pipe, smooth-drawn lead pipe, a pot drain, and a brick sewer; but protuberances might have the effect of obstructing the motion of heavy solid substances adventitiously present. It was also shewn, that the form of the transverse section of the sewer had much less influence on the action of the sewer than had been recently asserted by certain public authorities.

The experiments on the flow of water through pipes, as detailed in a recent blue book of the Board of Health, with the expressed object of demonstrating the ignorance of civil engineers on this subject, were brought under review. Some of the experiments had been repeated by Mr. Hawksley, with the utmost attention to minute accuracy. The results were found to be so utterly contradictory of the statements made, and the doctrines taught by

the General Board of Health, and so strikingly in conformity with formulæ well known to engineers, and with deductions from philosophic principles, as well as the determinations of practice, as to fully warrant all persons engaged in sewerage and other hydraulic works in continuing their adhesion to the established data. The experiments were shewn, and the formula was given.

April 13th.

The first paper read was entitled "*An account of a swing bridge over the river Rother, at Rye, on the line of the Ashford and Hastings Branch of the South-Eastern Railway.*" By Mr. C. MAY, M. Inst. C. E.

This bridge, which was constructed from the designs of Mr. P. W. Barlow, by Messrs. Ransomes and May, of Ipswich, although similar in principle to others previously erected, presented some difference in the construction,—in the arrangement of the tie-bars, in the rollers, and in other details. The girders were 112 feet long, 3 feet 6 inches deep in the centre, and 2 feet 6 inches at the ends, made up in four lengths,—one joint being in the centre, immediately over the support, and the others between the centre and the ends. These girders were secured together at their ends by means of cross girders, the under sides of which were planed, and inclined, so as to be slightly lifted, when swung home to their places on girders secured to the land piers. Provision was made on the under side of the main girders, at three places on each side of the centre of the bridge, for receiving the tie-bars, which all tended to one point over the middle. Each tie-bar was four inches by one inch in section, and was adjustable for tension by a right and left-handed screw, the nut of one end of which was in the tie-bar, and the other between two plates of wrought-iron resting on the side standards or A frames, which were connected together by a wrought-iron arch.

The turning of the bridge was effected by means of spur gearing, worked from a platform projecting from the face of each girder. Two men could with ease open the bridge in two minutes: the total weight of metal in the moving part, exclusive of the roadway, was about 130 tons.

The next paper read was, "*A description of the Lattice-beam Viaduct, to carry the Waterford and Kilkenny Railway across the River Nore, near Thomastown, County Kilkenny.*" By Captain W. S. MOORSOM, M. Inst. C. E.

The span of the bridge was extended to 200 feet, chiefly in order to avoid the interference of the Inspecting Officers of the Board of Works (Ireland), whose proceedings had, in other cases,

been so vexatious, as to cause great delay in the execution of works: in one instance, where a small arch of 12 feet span was to be built, crossing a stream, with a bottom of firm limestone rock, they had insisted on the excavation of this rock to a depth of 6 feet below the bed of the stream, and caused the foundations to be brought up in masonry from that depth. The length of the girder enabled the piers to be constructed on the banks without the aid of cofferdams. The foundation was strong loam and gravel, for an average of about 10 feet, at which depth the limestone rock was reached. The river was subject to floods, which, rising rapidly, spread across the valley for a breadth of 180 yards, and to a depth of about 16 feet in mid-channel.

The progress of the structure was delayed by the financial affairs of the railway company; and on the original contractors resigning the work, it was completed by several others, among whom was Mr. R. Mallet, M. Inst. C. E., whose able assistance in the execution of the work was deservedly eulogized by the author.

Details were given of the limestone piers, the material for which was quarried contiguously to the bridge; as also of the lime, and the modes of working.

The timber used for the lattice-beams or girders was Memel fir. The whole was worked to templates and gauges, and the beams were constructed with a curve or "camber," regulated by cleats, spiked to the staging on which the beams were built. The intersections of the diagonals were all very accurately fitted, and double spiked; the waling pieces were drawn close by bolts, and the joints made water-tight; the diagonal flooring was then bolted and spiked down; and on the trial of the beam, it was found that, on knocking away the cleats, the deflection was about 3 inches, which gradually increased to $3\frac{1}{4}$ inches: after passing several trains across, at speeds varying between 20 miles and 30 miles an hour, the ultimate deflection (without a load) became $5\frac{1}{4}$ inches. The maximum load had been 65 tons. The Government Inspector, however, tested it by a train of loaded waggons, extending the entire length of the arch (200 feet), and weighing 146 tons. The result of this was, that the beam deflected $2\frac{1}{4}$ inches under the heaviest load, and rose again $1\frac{1}{4}$ inch; thus leaving a permanent deflection, after the trials were concluded, of about $6\frac{1}{2}$ inches. The shrinking of the timber, and the regular traffic, produced a further sinking, so that now the entire amount was $7\frac{1}{4}$ inches; but the engineer had calculated and allowed for a subsidence of 9 inches.

Details were given of the quantities of materials of all kinds used in the bridge, the entire cost of which was about £8,100:—that of the timber arch alone was about £15 per foot run; and the cost of the whole mass, taken as a solid, averaged 3s. $3\frac{1}{4}$ d. per cubic yard.

April 20th.

The paper read was, "*The economy of railways, as a means of transit, comprising the classification of the traffic in relation to the most appropriate speeds for the conveyance of passengers and merchandize.*" By Mr. BRAITHWAITE POOLE, Assoc. Inst. C. E.

After referring to the influence which cheap and rapid communications had on the prosperity of a nation, the author alluded to the rise of the railway system in this country; expressing the belief, that it would have been economical and wise if the legislature had, in the first instance, determined the lines on which the system of railways should have been constructed throughout the kingdom, so as to have avoided the present ruinous competition. The passenger traffic now exceeded, annually, four times the entire population of Great Britain, and was conveyed at three times the speed and one-third the fares formerly charged by the old stage or mail coaches; whilst the cost of conveyance of merchandise, minerals, and agricultural produce, had been reduced full 50 per cent., as compared with the rates charged on canals and turnpike roads fifteen years ago. The ordinary fares for passengers ranged from two pence three farthings to a halfpenny per mile, and for merchandise, from one penny to sixpence per ton per mile.

The author then proceeded to consider the economy which might be introduced into the working of railways, and divided the subject into sixteen different heads, each of which referred to some particular point, where it was thought a reduction of expenses might be made. The principal point advanced was the amalgamating or working of all the railways in four great divisions, and ensuring unity of management in every department, in the maintenance of the permanent way, and of the rolling stock, as well as in their manufacture;—several improvements in the construction of the waggons being suggested.

If a general classification of trains were arranged throughout the kingdom, separating each class, and running them at different speeds whenever practicable, it was thought that it would be conducive to the interest of all parties; as it was urged to be a manifest injustice towards those who paid the highest fares, to find third class passengers arriving at the same time with them. Punctuality and regularity required to be strictly attended to for the maintenance of a certain definite speed.

Numerous instances were adduced to shew the vast advantages and economy of the railway system, without which the penny postage could not have been achieved, or the Great Exhibition rendered available to the multitude; the produce of the land and sea, in vegetables, fruit, meat, fish, all provisions, and fuel, would have remained as limited in consumption as heretofore; and the poor man's fire-side, in the rural districts, would never have been warmed by coal.

INSTITUTION OF MECHANICAL ENGINEERS, BIRMINGHAM.

28th Jan., 1852.

THIS being the Fifth Annual General Meeting, the proceedings commenced by reading the report of the Council; after which, the following paper, by Mr. ANDREW LAMB, of Southampton, was read:—

On an improved boiler for marine engines.

The Peninsular and Oriental steam-ship "Ripon" is an iron vessel, of 1650 tons burthen, and has two oscillating engines, of 450 nominal horse-power. She was built by Messrs. Wigram, in 1846, and was supplied with her machinery by Miller, Ravenhill, and Co., of London; since which time she has been almost constantly running for the conveyance of the Indian Mail from Southampton to Alexandria. Her average speed for the whole of this time has been 9·1 knots per hour. The boilers fitted to her by Messrs. Miller were of the ordinary tubular construction. They were in six pieces, had twelve furnaces, and 744 iron tubes, 3½ inches outside diameter, 6 feet 6 inches long. The total fire-bar surface was 212 square feet, and the heating surface in the tubes 3798 square feet, reckoning the whole of the inside surface of the tubes as effective. The sectional area through the tubes equals 36½ square feet; ditto through ferrules, 28 square feet.

These boilers were loaded to 10 lbs. on the square inch; but, in consequence of being deficient in steam, the actual pressure attained at sea very seldom exceeded 4 to 6 lbs. when full steam was admitted to the cylinders;—of course the engineers found it to their advantage to keep it up to its full pressure by working the expansion apparatus. This deficiency of steam was found to be an increasing evil; the cause for which may be satisfactorily explained by a little consideration of the *modus operandi* of the sea-going tubular boiler. When commencing to run with the boilers new, for a short period, dependent on the species of coal consumed, the tubular boiler offers its greatest advantage, and is, in fact (when properly constructed), as good an apparatus for evaporating water as can be imagined applicable to marine purposes. The tubes give a large amount of heating surface, in small compass, and, from their form, are capable of resisting great pressure; but, after three or four days' steaming, these advantages diminish. The tubes have an accumulation of soot and light ashes inside them, which, by reducing their sectional area, sometimes from 50 to 75 per cent., diminishes the draft through the furnaces in the same proportion, and also reduces the effective heating surface to the same serious extent. This accumulation depends, in quantity, very much upon the coal. On one occasion, the author was present in a vessel with tubular boilers, burning Scotch coal, and they actually came to a dead

stand, after only sixty hours' steaming,—the tubes being nearly choked up, and requiring to be swept. When tubular boilers have made a few voyages at sea, the outside of the tubes becomes encrusted with saline matter (chiefly upon their bottom sides), which, hitherto, it has been found impossible to remove by any other means than scaling them mechanically. The situation of the tubes (row over row) prevents this being accomplished, excepting upon the upper tiers; and the consequences are, that the tubes and tube-plates become coated with a crust $\frac{1}{4}$ or $\frac{3}{8}$ ths of an inch thick, which, from its non-conducting nature, greatly retards the transmission of the heat through it; and the tube-plates becoming hot, crack and blister, and deteriorate very rapidly.

To avoid these defects was the object of the author in designing the boiler to be described in the present paper, and patented by him in conjunction with Mr. Summers. The first advantage claimed for it over its tubular competitor is—that, while it possesses an equal amount of heating surface in the same space as tubular boilers, it is free from the evil of choking with inside deposits of soot and ashes; because the flues, being in one sheet for their whole depth, the deposit falls into the bottom of the flues, and is swept by the draft through into the uptake, and thence into the chimney.

In the boilers used in the Ripon, numerous flues are fixed in the same position as the tubes in an ordinary tubular boiler, and form the return-passage from the back of the fire-grate to the uptake leading to the chimney. The flues are flat rectangular chambers, 6 feet 9 inches long, and 3 feet 3 inches high, open at each end, where they are fixed to the boiler. There are seven of these flues to each fire-grate: the smoke spaces are $1\frac{1}{2}$ inches wide, and the water spaces $2\frac{1}{8}$ inches. The sides of the flues are $\frac{1}{4}$ inch thick, and they are supported by stays, fixed inside them. From this circumstance, of there being no stays or other projections in the water spaces, an important advantage is gained—that no nucleus is offered round which the scale can collect, and no impediment to interfere with the complete and rapid cleansing of the water spaces from scale by means of the ordinary scrapers.

In another arrangement of these boilers, adapted for large screw steamers, and also for war steamers, the flues are placed alongside the furnaces, and at the same level, instead of over the furnaces: which arrangement protects the boilers from shot, by keeping them below the water-line.

In these improved boilers, the same amount of heating surface can be obtained in the same capacity of boiler as with the tubes: the only difference is, that if the tubes are $\frac{3}{8}$ ths of an inch thick, they will, of course, be rather lighter than $\frac{1}{4}$ -inch plates. In the event of any accident to any of the flues, they may be taken out, separately or collectively, to be repaired or replaced with new ones; but, from the facility with which they can be kept

clean, they ought, as in the old-fashioned flue-boilers, to wear out the shell—the length of time being remarkable that a thin plate will last, if kept clean, and never overheated.

The second advantage claimed for the improved boiler is—that the flues, from having no projection, either of rivet heads or stays, in the water spaces, offer no obstructions whatever to the scaling tool, and are as easily kept clean as any part of any boiler can possibly be; thereby entirely removing the evil of a loss of heat through non-conducting deposits, and very much increasing the durability of the boiler. The third advantage is—that the water spaces between the flues being comparatively large, and the sides of the flues perfectly vertical, the circulation of water in the boiler must necessarily be much more perfect than amongst a number of tubes (amounting sometimes to thousands), where the water has to wend its way in and out in curved lines.

The improved boilers now fitted to the Ripon were manufactured by Messrs. Summers, Day, and Baldock, of Southampton, and are in four parts;—the boilers being placed in the wings, two forward of the engines and two aft: the stokeholes are thus in midships. The space occupied by these new boilers is the same as the old ones. The new boilers have 16 furnaces, and 246 square feet of fire-bar surface; they have 112 flues, 3 feet 9 inches deep $\times$ 6 feet 3 inches long, being 5440 square feet of heating surface, reckoning the whole inside surface (as in tubes); and the sectional area through the flues, deducting the stays, equals 54 square feet. This large sectional area can be diminished at pleasure, by a damper, which is hung at the front end of the flues, and extends about 10 or 12 inches down them. The new boilers of the Ripon are loaded to 13 lbs. per square inch.

The Ripon, at the same time that the boilers were altered, had her common radial paddle-wheels replaced by feathering ones, which, consequently, added much to the speed of the vessel. The best speed of the engines of the Ripon with the old arrangement was about 15 revolutions per minute, and that of the vessel about 10 knots per hour when quite light.

On the trial at the measured mile, December, 1851, the vessel was drawing 16 feet 3 inches forward, and 16 feet 7 inches aft; she had all her coal (422 tons) on board, her water, and some cargo; and, consequently, was pretty deep loaded. The speed of the engines was $19\frac{1}{4}$ revolutions per minute, and of the vessel 11.3 knots per hour. Had she been light, as in the former trial, she would have probably gone over 12 knots. It appears, therefore, that the improvement in speed may be fairly stated as 2 knots per hour. The cylinders of the engines are 76 inches diameter $\times$ 7 feet stroke. Their nominal horse-power formerly, at 15 revolutions, would be 404, and at $19\frac{1}{4}$ revolutions, 526 horse-power; so that the new boilers have given 122 horse-power more steam, of an increased pressure of 3 lb. per square inch, than the old ones.

As the *Ripon* is now making her first voyage with the new boilers, the author cannot speak with any certainty about her consumption; but he gives some details of the *Peninsular* and *Oriental* steam-ship *Bentinck*, which has made one voyage to Alexandria and back with these improved boilers and feathering wheels. The *Bentinck* is a wooden vessel, built by Wilson, of Liverpool, in 1844, and has side-lever engines, by Fawcett and Preston. She is 2020 tons burthen, and her engines are 520 nominal horse-power; her original boilers were of the old flue construction, and were loaded to 6 lbs. per inch pressure; her average speed at sea was 9 knots per hour, and her engines about 14 revolutions per minute. Her speed is now over 11 knots per hour. The former consumption was about 37 cwt. per hour; the present consumption averages about 38 cwt. per hour.

It must be noticed, that the *Peninsular* and *Oriental* Company had tubular boilers, with brass tubes, made for this vessel by Messrs. Bury, Curtis, and Kennedy, and that they were brought to Southampton, and placed in the *Pottinger*, a sister ship of the *Ripon*, and of 450 nominal horse-power, with common paddle-wheels. These boilers are of exactly the same size as the patent boilers made for the *Bentinck*, and they are both loaded to the same pressure, viz., 12 lbs. per square inch; they have each made a passage to Alexandria and back; and, contrary to all expectation, the *Bentinck*, although her engines are 70 horse-power nominal more than the *Pottinger*, and are working up to 103 horse-power more, has consumed 128 tons less coal than the *Pottinger*, and performed the same distance in $68\frac{1}{2}$ hours less time. This result of diminished consumption is a fair triumph for the improved boiler;—as for the improved speed of the vessel, it must share the honors with the feathering paddle-wheel.

The following paper, by Mr. WILLIAM HANDLEY, of London, was then read:—

On an improved brake for railway carriages.

After explaining some of the improvements which have been proposed in the construction of railway brakes, the author proceeded to describe the brake which forms the subject of this paper. It is on the same principle as the ordinary skid used on common roads. A piece of iron, formed with two long descending arms, and a short upright arm at the top, is mounted on the axle, near each end thereof. The two long arms stand at an angle of 120° to each other; and at the end of each is fixed a shoe or skid,—one of which is made to pass under the wheel, whichever way the carriage is running, and elevate it from the rails, by turning the piece of iron or lever round upon the axle. The shoe is made the breadth of the tread of the wheel, without any flange, and the wheel is lifted only about one-eighth of an inch on the average; so that the flange of the wheel continues as effi-

cient and secure a guide upon the rails as in the ordinary case of a wheel stopped from revolving by the pressure of a brake-block. The shoe is made in two pieces;—the upper one is forged on to the long arm; and the lower piece, which forms the skid, is hinged to it at the end. The object of this construction is to prevent the shoe from touching the wheel until it is required to be put in action: the joint opens about a quarter of an inch; and the shoe falls away from the wheel when it is lifted,—being stopped by a bolt, which limits the extent of its opening; and, round this bolt is placed a short spiral spring, to keep the joint open, and prevent it from shaking when the carriage is running. The wear of the shoe is provided for by inserting two small dove-tailed pieces at the points where the wear takes place: these pieces are slightly tapered, and are driven into their places from the inner side,—being burred or rivetted on the opposite side, where they remain firmly fixed, having no tendency to work loose. The lower piece is of wrought-iron, which is found to answer best for the purpose; and the upper one, which carries the wheel, is of cast-iron: it has very little wear upon it, but is changed occasionally for a piece of greater thickness, to allow for the wear of the shoe-plate, and preserve the total thickness of the shoe, within very little variation, so as to prevent much difference in the height that the wheel is lifted from the rails.

This brake is easily and quickly applied, by means of a lever acting on the short upper arm of the brake: as the carriage runs upon the shoe when it is pressed under the wheel, it requires less force than the ordinary brake, and is put on more quickly. The ordinary brake-screw, lever, and cross-shaft, are available for working this brake.

This mode of braking has the advantage of keeping the wheels perfectly circular, and preventing them wearing polygonal, which, under the ordinary mode, converts them, in fact, into so many hammers beating upon the rails, to the no small detriment of the permanent way. As the wheels rest upon the skid, which slides along the rail, the axles are saved from that strain and torsion which necessarily arise when blocks are pressed with great force against the wheels to stop them. When wheels are stopped with the ordinary brake, the surface bearing upon the rails is so small that it follows into the soft and hollow places of the rails, and makes them worse; but this shoe, having a bearing of sixteen inches, passes over them, and saves the rails from that wear. In consequence of the axle being taken for a bearing, and the pressure being downwards, in the same manner as when the wheel is running, the action of the springs is not in the least interfered with, and the carriage runs as easily, and without any jar, when the brake is put on as when it is off. The wheels are also kept quite cool,—saving the tires thereby from expansion.

The following paper, by Mr. JAMES SAMUEL, of London, was then read:—

On a continuous-expansion steam-engine.

The greatest useful effect is obtained from steam when it is allowed to expand in the cylinder until its pressure upon the piston just balances all the useless resistance of the friction of the engine itself, and the resisting pressure on the back of the piston (whether the pressure of the atmosphere, in a high-pressure engine, or of the uncondensed vapour, in a condensing engine),—the surplus power beyond these useless resistances being alone available for the purposes to which the engine is applied. But, in driving machinery, so great a uniformity of motion is essential, that any great variation in the moving power throughout the stroke of the engine is inadmissible; as the fly-wheel would not be able to absorb enough of the excess of power to equalize the velocity sufficiently, by giving it out again at the deficient part of the stroke: consequently, though two engines are often employed, working at right angles to each other, for the purpose of diminishing the variation in total moving power, the expansion principle can only be carried to a portion of the extent to which it is theoretically applicable. Only in such engines as the large Cornish pumping engines can the expansion be carried practically to its full theoretical limit; as the variation in the velocity of the load moved is of much less importance in those engines; and the very unequal amounts of moving power that are developed in equal times, by the full carrying out of the expansive principle (which would produce the most prejudicial and inadmissible variations of velocity in the engine), are controlled within prescribed limits by the great weight of material to be moved by the engine in the pump rods and balancing machinery,—forming, as it were, a distributing reservoir for the moving force developed.

In the locomotive engine there are practical difficulties in carrying out the expansion principle efficiently, beyond a moderate extent, in a single cylinder, from the shortness of stroke and rapidity of reciprocation, and the construction of the valve motion; but the ultimate extent to which it could be carried would be limited by the maintenance of the blast, which requires that the jets of steam discharged from the cylinder into the blast-pipe should not be reduced below a certain pressure at the moment of discharge. Otherwise, the limit to which expansion might be carried would be the resistance of the atmosphere to the discharge of the steam, added to the friction of the engine—say about 10 lbs. per inch above the atmosphere. The steam is cut off usually by the link motion at from one-third to two-thirds of the stroke, and the steam is consequently discharged into the blast-pipe at about from 30 to 60 lbs. pressure above the atmosphere, supposing it to be supplied to the cylinders at 100 lbs.

per inch above the atmosphere. It appears that the lower of these pressures is sufficient, or more than sufficient, for the purposes of the blast, to maintain fully the evaporative power of the boiler under general circumstances, and that a portion of the steam discharged can be spared from the blast to be subjected to a greater extent of expansion.

In the continuous-expansion engine, the subject of the present paper, the steam from the boiler is supplied only to one cylinder; a portion of it is expanded into the second cylinder, which is of proportionately larger area, so as to equalize the total moving power of the two cylinders; and it is there further expanded down to the fullest useful extent, and then discharged into the atmosphere;—the portion of steam remaining in the first cylinder being discharged as a blast at nearly the same pressure as in the ordinary engines. The economy, therefore, consists in obtaining from such portion of the steam as can be spared from the blast, the additional power of expansion remaining in it, which is thrown away in the ordinary engine.

The steam is admitted into the first cylinder in the same manner as in the ordinary engines, and cut off at half stroke; and a communication is then opened with the second cylinder. The second cylinder is about double the area of the first cylinder, and the same length of stroke; but the cranks are set at right angles, as in ordinary locomotives; and, consequently, at the moment of the steam being passed into the second cylinder from the first, the piston of the second cylinder is at the commencement of its stroke. The steam continues expanding in the two cylinders until the first piston has nearly completed its stroke, when the communication between the two cylinders is shut off, and the steam remaining in the first cylinder is discharged into the blast-pipe. The second piston has then arrived nearly at half stroke, and its cylinder contains nearly one half of the total quantity of steam originally admitted to the first cylinder; and this steam is further expanded to the end of the stroke, and then discharged into the blast-pipe. The return-stroke of both pistons is exactly similar to the foregoing; so that about $\frac{1}{2}$ cylinder full of high-pressure steam (or such other portion as may be desired) is supplied to the first cylinder at each stroke; and between $\frac{1}{4}$ and $\frac{3}{4}$ rds of that steam is discharged at the pressure required to produce the blast; and the remainder of the steam is expanded in the second cylinder, so as to give out all the available power remaining in it. For the purpose of enabling the engine to exert an increased power, if required, at the time of starting a train, or otherwise, the communication between the two cylinders can be closed for a short time when required; and the steam from the boiler is admitted into the steam-chest of the second cylinder which is then worked independently of the other cylinder, like an ordinary engine.

SOCIETY OF ARTS.

February 18th, 1852.

The arts and manufactures of India. By PROFESSOR J. FORBES ROYLE, M.D., F.R.S.

THE lecturer introduced his subject by a brief notice of the early history of the arts in India, and their probable effect upon the civilized nations of antiquity. He then proceeded to treat of the arts and manufactures of India under the following heads:—

1. Chemical Arts; 2. Textile Arts; 3. Manual and Mechanical Arts; 4. Fine Arts.

The arts which are strictly chemical, he said, may be supposed to have originated only in a country where the science of chemistry had made some advance; but the Hindoos are not usually supposed to have paid any attention to this subject.

We know, from a variety of sources, that the Hindoos have long been acquainted with many chemical substances, as well as that they have practised many chemical arts. The ordinary metals, including tin, they have long known, and have prepared the oxides of iron, lead, tin, and zinc. The ashes of plants, in a country of wood fires, led them to the discovery of potash. Soda is found effloresced on the soil, as well as crystallized on the margins of some of their lakes. Nitre must have been produced then, as now, in their soil, and borax imported from Thibet; while sal-ammoniac must have been produced ever since they made bricks as they now do. Alum they obtain by throwing potash on alum slate, which has been some time exposed to the air. Among the salts of the metals we find the sulphates of copper, of zinc, and of iron, the acetates of copper and of iron, and the carbonates of lead and of iron. They seem, also, to have been long acquainted with the three mineral acids, for making which they have peculiar formulæ; while their lemons and limes gave them citric, and the gram-plant (*cicer arietinum*) the oxalic acid.

It is difficult to understand how a primitive people could have overcome the difficulties of smelting iron and of forging steel, yet the Hindoos have long known both these arts. It is curious to see a native, with no other tools than his hatchet and his hands, proceed to smelt iron, which he will convert into steel, capable of competing with the best prepared in Europe. For this the prevalence of the black oxide of iron, in the state of iron sand, and the common use of charcoal as a fuel, give him some facilities, while he prepares a furnace with clay, and makes bellows with the leaves of the forest. Even now the best Persian swords are made with steel imported from India.

Mr. Heath, at one time the managing director of the India Iron and Steel Company, describes the ore used as the magnetic oxide of iron, consisting of seventy-two per cent. of iron with twenty-eight of oxygen, combined with quartz, in the proportion of fifty-two of oxide to forty-eight of quartz. It is prepared by

stamping, and then separating the quartz by washing or winnowing. The furnace is built of clay alone, from three to five feet high, and pear-shaped. The bellows is formed of two goat-skins, with a bamboo nozzle, ending in a clay pipe. The fuel is charcoal, upon which the ore is laid, without flux; the bellows are plied for four hours, when the ore will be found to be reduced; it is taken out, and, while yet red-hot, it is cut through with a hatchet, and sold to the blacksmiths, who forge it into bars and convert it into steel. In an old account, in possession of the lecturer (written apparently at Mysore), it is said, that one pound and a half of iron is heated lower than red heat, and then beaten for about three minutes with a stone hammer on a stone anvil. Experience having taught them, they say, that instruments of iron ruin the process. Mr. Heath says the iron is forged by repeated hammering, until it forms an apparently unpromising bar of iron, from which an English manufacturer of steel would turn with contempt, but which the Hindoo converts into cast steel of the very best quality. To effect this, he cuts it into small pieces, of which he puts a pound, more or less, into a crucible, with dry wood of the *Cassia auriculata*, and a few green leaves of *Aeclepias gigantea*; or, where that is not to be had, of the *Convolvulus laurifolia*,—the object being to furnish carbon to the iron. As soon as the clay, used to stop the mouths of the crucibles, is dry, they are built up in the form of an arch in a small furnace—charcoal is heaped up over them, and the blast kept up without intermission for about two hours and a half, when it is stopped, and the process is considered complete. The furnace contains from twenty to twenty-four crucibles. The crucibles are next removed from the furnace and allowed to cool; they are then broken and the steel taken out. The crucibles are formed of a red loam, which is very refractory, mixed with a large quantity of charred husk of rice.

Among the arms sent to the Exhibition were some that would appear to belong to different ages of the world, but which are actually in use in India at the present day; such as chain and scale armour, both for man and horse, helmets and shields, spears, battle-axes, bows and arrows, with daggers in every variety. Some of these display in a remarkable manner their skill as cutlers; as, for instance, the sword formed of two blades, and another in which pearls are let into the centre of its blade; and still more, in the daggers contained one within another, all of hard steel, with the line of junction so beautifully welded as to be hardly perceptible even with a magnifier; so also in the dagger, which, on striking, separates into five blades, as these are most nicely brought into juxtaposition. The twisting of gun-barrels and the damasks of their blades of steel have been imitated in all countries.

A metallurgical compound of considerable interest is that which has been named Bidery (from Bider, a city situated about sixty miles to the north-west of Hyderabad), and of which we have had a variety of articles at the Exhibition. Dr. Heyne informs us

that it is composed of copper sixteen ounces, lead four ounces, and tin two ounces. These are melted together, and to every three ounces of the alloy, sixteen ounces of spelter, that is, of zinc, is added, when the alloy is melted for use. But to give the whole the black color which is esteemed (probably from bringing out the pattern), it is dipped into a solution of sal-ammoniac, saltpetre, common salt, and blue vitriol. Dr. B. Hamilton saw of zinc 12,360 grains, copper 460 grains, and lead 414 grains, melted together, and a mixture of resin and bees-wax introduced into the crucible, to prevent calcination. It was then poured into a mould made of baked clay, and the article handed over to be turned in a lathe. Artists then inlay flowers or other ornaments of silver or of gold. They first rub it over with sulphate of copper and water, which gives the surface a blackish color, and enables the artist more easily to distinguish the figure which he draws,—this he does with a sharp-pointed instrument of steel, and cuts it with small chisels of various shapes; and then, with a hammer and punch, he fills the cavities with small plates of silver, which adhere firmly to the Bidery. It is then polished and stained, as described above. The various articles made from it are vases, wash-hand basons and ewers, hookah-bottoms, spittoons, cups and dishes, small boxes, and weights. These are inlaid commonly with silver, but sometimes with gold. The patterns are usually as much to be admired as the forms of the vessels.

Glass is one of those discoveries which could hardly escape being made by any people who employed furnaces to reduce metallic oxides; for the necessary ingredients must often have been present, and the heat was sufficient. The natives of India seem to have been long acquainted with this manufacture.

One of the simplest processes for making glass is that practised in the district of Behar. The saline efflorescence of the soil (which is an impure carbonate of soda) is collected, and thrown into a cistern lined with clay. This is then filled with water; which is afterwards allowed to evaporate. When dry, the bottom of the cistern is found covered with a thick saline crust;—the earth which was intermixed having subsided before the salt began to crystallize. This soda makes glass without any addition, as it still contains a sufficient portion of siliceous matter. They make blackish and greenish glass: a bright grass-green is made by additions of oxide of copper, and a blue glass by the addition of *runq*. In Mysore the process is more elaborate. Powdered white quartz, one part, being mixed with prepared soda, six parts, is filled into a crucible capable of containing $5\frac{1}{2}$ Winchester gallons. About fifty of these crucibles are placed in a furnace, and the fire kept up for five days; whereby a frit is produced, with which they make a black, green, red, blue, and yellow glass, by means of additions of oxide of copper, of an ore called *kemudu*, and of a blue substance called *runqa*.

The art of enamelling is known in every part of India; and some exquisite specimens were sent to the Exhibition, both from Central and from North-Western India: it is chiefly em-

played in ornamenting arms and jewellery,—not only in gold, but also in silver. Enamels being vitrifiable substances, to which peculiar colors are given, we may compare the Indian with the European methods of making enamel. In general, ten parts of lead and three parts of tin are oxidized by continued heat and exposure to the air. To the mixed oxides, add ten parts of powdered quartz, and ten parts of common salt, and melt in crucibles. Thus is obtained a white enamel, and the basis of colored enamel, metallic oxides being added. The oxide of lead or of antimony produces a yellow enamel; reds are obtained by a mixture of the oxides of gold and iron. The oxides of copper, cobalt, and iron, give greens, violets, and blues; and a variety of intermediate colors by mixtures.

The art of fashioning clay into vessels of a variety of shapes, and hardening it by the action of heat, is one of the most ancient of the arts. Fragments of pottery are everywhere found among the ancient cities of India, as in those of other parts of the world.

The clays which are generally employed by the Indian potter, contain so much oxide of iron and carbonate of lime, that the vessels melt into a slag at a temperature little above that of redness. Deposits of a black stiff clay, containing much vegetable matter, occur in some districts: vessels made with it sustain a higher temperature. Clays, capable of sustaining great degrees of heat, have, however, been discovered in different parts of India. As one great object is to have porous vessels, for cooling water, the ordinary clays answer sufficiently well for this purpose; and some of the forms (as that of the tortoise-shaped) expose a large surface to the air. The Hindoos, moreover, never use a vessel the second time; so no great expense will be incurred by them: thus encouragement is wanting to improve the nature of their pottery.

The ancient potter's wheel is the instrument with which the Hindoo potter works; and while it revolves, with the aid of his naked hands, he fashions vessels of elegant forms, many of which have been admired as being of classical shapes, and some would appear almost as if they were of Etruscan origin.

It has been supposed that the Hindoos learned the art of dyeing from the Egyptians; but the probability is as great that the latter learned the art from the former; from whom also they probably obtained the alum which was celebrated by the name of Egyptian alum. Alum is still manufactured in Cutch. The natives of India have long known the use of sulphate of iron and of acetate of iron. The latter they prepare by macerating iron in sour palm-wine, or in water in which rice had been boiled. The Exhibition has shewn that they can dye every color, and of a great variety of shades, and that, in a complicated pattern, they know the value and power of each in contrasting the effect of others, so as produce an harmonious whole.

In speaking of textile fabrics, the lecturer said, that India, notwithstanding the great mechanical inventions of this country, is still able to produce her "webs of woven air," which a Man-

chester manufacturer, of the last century, attempted to depreciate, by calling them "the shadow of a commodity," at the same time that his townsmen were doing all they could to imitate the reality, and which they have not yet been able to excel.

Though the invention and completion of a loom for weaving would indicate a high degree of ingenuity, as well as a considerable advance in some other arts, the Hindoos were acquainted with it at a very early period; for in the hymns of the Rig Veda, composed at least 1200 years B.C., "weavers' threads" are alluded to; and in the Institutes of Manu it is directed,—“Let a weaver, who has received ten palas of cotton-thread, give them back increased of eleven by the rice-water and the like used in weaving.”

That the Hindoos were in the habit of spinning threads of different materials appears from another part of the Institutes of the same lawgiver, where it is directed that the sacrificial threads of a Brahmin must be made of cotton, that of a Shatriya (second caste), of *sana* (*Crotolaria juncea*), and that of a Vaisya, of woollen thread. The natives of India prepare fabrics not only of cotton, but also of hemp, and of *jute*, and other substitutes for flax; also of a variety of silks, and of the wool of the sheep, goat, and camel, as well as mixed fabrics of different kinds. But it is for the delicacy of the muslins, especially of those woven at Dacca, that India has so long been famous.

Fine muslins have been sent to the Exhibition, not only from Dacca, but also from Kishenigurh, in Bengal; likewise from as far south as Cottar, in the Rajah of Travancore's dominions, as well as from Chundeyree, in the Gwalior territories. Specimens of almost every variety of the cotton manufacture, such as the coarse garrhas and guzzees for packing, clothing, and for covering corpses, with dosootees, &c., for tents, canvass for sails, towels, and table-cloths, and every variety of calico, have been sent from the islands of the Indian Ocean, from Nepal and Assam, as well as from all along the valley of the Ganges, from Bengal up to the Jullundur Doab, in the Sikh territories; also from Cutch, Ahmedabad, Surat, and Dharwar, on the western side of India; and from the central territories of the Nizam, and of the Rajah of Nagpore. The finest specimens of calico, and punjum longcloth, have been sent from Jugginpettah, in the Northern Circars, which was formerly the great seat of this manufacture.

Among the fabrics there are a great variety, which prove that the natives are acquainted with every kind of weaving, from guzzees and gauzes, to striped, chequered, and flowered muslins. The last are interesting as specimens of an art which has been long known in the East, and the mode of making which has puzzled weavers in this country.

A few very splendid specimens of silk carpets were exhibited, especially the large one which was hung up to the eastward of the tent, and was contributed by Maharajah Goolab Sing. It was as beautiful a specimen of variety in the pattern, brilliancy in the coloring, as well as of pleasing harmony in the whole, as

any in the Exhibition building. A smaller one, of the same pattern, was laid within the tent, together with another, in the same style, from Mooltan. Other silk carpets, but of small size, were sent from Tanjore, Hyderabad, and Khyrpore. Woollen carpets, of large size, and of beautiful and well-colored Oriental patterns, were sent from Mirzapore and from Goruckpore. The former is most famous in India for its carpets, which are frequently sold in this country as Turkey carpets.

The Indian lace, when seen at the Exhibition, was said to be much admired. Samples of six different kinds were sent. Gold and silver blond lace are both excellent of their kinds; but, as the demand is limited, and fashion changeable, they might not always command a sale. But the broad black lace on wire-ground, and the broad white and fine lace on Brussels ground, and of the nature of Bedfordshire lace, are highly approved of by the best authorities: the broad being thought worth four shillings, and the narrow worth two shillings per yard.

Among the embroidered articles, those from Dacca and from Delhi are probably the best known. In the latter, small shawls and scarves are chiefly embroidered, both with floss and twisted silk; in the former, both nets and muslins, with floss silk of various colors. But Dacca is also famous for its embroidery of mualins with cotton, of which specimens of different articles of clothing have been sent from Calcutta; also an infant's robe of grass-cloth, worked at Serampore, and a scarf and handkerchief of pine-apple fibre, from Madras. One kind is formed by breaking down the texture of the cloth with the needle, and converting it into open meshes.

The beetle-wing embroidery, from Madras, was particularly elegant; and the velvet awnings, musnud-covers, hookah carpets, and elephant trappings, embroidered with gold and silver, chiefly at Moorshedabad and Benares, were admired as well for the richness as the skill with which the ground-work was allowed to relieve the ornaments. The embroidered saddles and saddle-cloths, and floor-coverings from Pattiala, Mooltan, and Lahore, were of the usual style of what are called the works of that famed valley, and which was conspicuously shewn in the dresses, caps, and slippers from Cashmere itself.

The skill of the Hindoos in carving was shewn in the black wood furniture from Bombay; especially in the elegance of the patterns of the backs of the chairs and sofas, in the sideboards, and book-cases. So also in the ebony screens from Madras, carved by Moangapa Achong, a native carpenter of Madras, without any European assistance.

Among ivory-carvers, those of Berhampore are conspicuous, who have sent a little model of themselves at work, and using—as is the custom of India—only a few tools. The set of chessmen, carved from the drawings in Layard's "Nineveh," were excellent representations of what they could only have seen in the above work: shewing that they are capable of doing new things

when required; while their representations of the elephant, and other animals, are true to nature. The carvings in the same material in the state chair from Travancore were greatly admired, and from the truth of representation on a minute scale, where an elephant is enclosed in the shell of a pea, from Calicut; also in the beautiful specimens of minute carving, sent by his Highness the Nizam of Hyderabad. The chouries, or fly-flappers, where the ivory, or sandal-wood, is cut into long hair-like threads, are also specimens of their mechanical skill; while their skill in wood-carving was conspicuously displayed in the elaborate details of the sandal-wood boxes from the Malabar coast, and also in the Musjid exhibited by Mr. Mansfield, from Ahmedabad, and in the Hindoo temples from Cutch; also in the box, made of an African wood, from the Rao of Cutch.

But the skill of the Indian carver is conspicuously shewn in the beauty, both of the figures of the Rajah and Ranee of Travancore, and of the buildings, in so soft and yielding a material as pith, or rather in the pith-like stems of the marsh-plant. In the latter, all the elaborate detail of the richly-ornamented Hindoo architecture of the South of India is carefully brought out. For this work only two tools seem to be employed,—one a large and heavy knife, the other with a fine sharp cutting edge.

Working in stone, polishing the hardest surfaces, engraving its surface with imperishable records, and sculpturing it into various forms, even excavating gigantic temples out of the solid rock,—are all departments of sculpture and engraving to which the Hindoos have paid attention from the earliest times; and their buildings are conspicuous for a quality for which those of Egypt have often been admired: that is, the exquisite polish and glass-like appearance of some of the hardest granite. The tools which the Hindoos use, are a small steel chisel, which tapers to a round point, like a drawing-pencil, and an iron mallet, with only one striking face, which is formed into a tolerably deep hollow, and lined with lead. With such simple instruments they formed, fashioned, and scooped the granite rock which forms the tremendous fortress of Dowlatabad, and excavated the wonderful caverns of Ellora.

The mode of polishing stone is as follows:—A block of granite, of considerable size, is rudely fashioned into the shape of the end of a large pestle. The lower face of this is hollowed out into a cavity, and this is filled with a mass composed of pounded corundum-stone mixed with melted bees'-wax. This block is moved by means of two sticks, or pieces of bamboo, placed on each side of its neck, and bound together by cords, twisted and tightened by sticks. The weight of the whole is such as two workmen can easily manage. They seat themselves upon, or close to, the stone they are to polish, and, by moving the block backwards and forwards between them, the polish is given by the friction of the mass of wax (and lac?) and corundum.

Nearly the same materials, and with a still greater degree of
VOL. XL. 3 B

success, are employed in polishing such delicate articles as beads and bracelets, and the beautiful agate, jade, and crystal cups, which were purchased at Lahore, and exhibited in the jewel-cases of the Indian collection.

Those who can give a lustrous polish to granite, and appear to mould crystal cups into as elegant forms as the softest clay, can find no difficulty in carving sandstone or in cutting marble. But the elegance and variety of the patterns into which both sandstone and marble are cut, is conspicuous in the open lattice-work with which tombs are surrounded in north-west India. These are, moreover, remarkable for the light and aerial, almost lace-like appearance, with which they impress the observer at a little distance. Two good specimens of these screens, in sand-stone, were sent from Mirzapore, and, on a smaller scale, from Boondee.

The Fine Arts, as the term is generally understood, have not attained such a degree of excellence in India as to bear any favorable comparison with the state of the fine arts in Europe; yet there are some things under this head, and not beyond the limits of the Exhibition, which are not unworthy of notice.

The Hindoo painters are admirable delineators of objects of natural history; hence, most of the illustrated works which have been published on the Indian branches of this subject have usually been drawn by native artists, several of whom are constantly employed in the East India Company's Botanic Garden, at Calcutta. They are usually faithful copyists, but are often objected to as being stiff in their style, and not paying sufficient attention to perspective; but this is hardly worse than the artistic palm-trees which one sees in European drawings, and which are very unlike those with which nature adorns her own pictures.

The only paintings by the native artists which we have had in the Exhibition are several series in talc, some from Trichinopoly and the others from Delhi: the latter giving a representation of the different officers and dresses at the Mahomedan ceremony of the Mohurran, and of the different servants in the employ of Europeans; while the trades, as well as many agricultural operations, were represented in the drawings from the south.

The Exhibition also afforded specimens of sculpture, gem engraving, mosaic work, and enamelling, which displayed great executive skill, and were considered by the lecturer to prove, that if the Hindoos had not made any great advances from their ancient civilization, they had, at least, not made the retrograde progress of other nations of antiquity.

March 3rd, 1852.

On the progress of naval architecture, as indicating the necessity for scientific education, and for the classification of ships and of steam-engines; also on life-boats. By CAPT. WASHINGTON, R.N., F.R.S.

The lecturer commenced his address by giving a concise sketch of the progress of naval architecture in Great Britain, illustrating

his remarks by reference to the models in the Exhibition, which were said to mark the great steps made in this branch of knowledge, but not the gradual progress of its development. Allusion was made to the tardy acknowledgment of our inferiority to France and Spain in ship-building; and it was shewn, that this was entirely owing to the want of scientific investigation in our dockyards; whilst the most learned mathematicians were employed in other countries to guide the workman to practical improvements. Of late years, this had, in great part, been remedied; and we might now boast of many admirable treatises on the art of shipbuilding. The lecturer took the opportunity of offering a tribute of praise to the Thames Yacht Club and the Royal Yacht Squadron, for the benefit they had conferred upon naval architecture. He then alluded to screw and paddle steamers,—shewing the advantage derivable from free competition, and from the builder and engineer working in concert. Having noticed very briefly the models illustrating fishing-boats, he proceeded to speak of life-boats, expressing his regret that the large subject of shipping, which is the business of a professed naval architect, should have been left to a sailor to treat upon, who could only pretend to a little knowledge upon one point, viz., life-boats. In relation to this subject, he made the following remarks:—

The form best adapted for the general purposes of a life-boat is that usually given to a whale-boat,—that is, both ends alike, but with more breadth of beam; fine lines, to enable the boat to pull well, but sufficient fullness forward to give buoyancy for launching through a surf; good sheer of gunwale, say an inch for each foot of length, but rounded off towards the extremes; a long flat floor; sides straight in the fore-and-aft direction; the gunwale strake in the midships to tumble home slightly, to protect the thole-pins; and the bow strake to flare out slightly, to throw the sea off; and as much camber or curvature of keel as can be combined with steady steering and safe launching from a beach, in order that the boat may be turned quickly to meet a heavy roller, when about to break on her broadside.

In point of length, life-boats may be conveniently divided into three classes—from 20 to 25 feet, from 25 to 30 feet, and from 30 to 36 feet: which last may be considered the maximum, and a length rarely required. The smaller-sized boat is handy on those parts of the coast where it is difficult to find a crew—a difficulty that would be found to extend to a great part of the shores of this kingdom.

The medium, or 30-foot boat, to pull ten oars double banked, is probably the best adapted for the general purposes of a life-boat, at all places where a sufficient crew can be readily found to man her. Such boats are in use at Liverpool, Shields, Dundee, and other large ports, where no difficulty is experienced in finding a crew; and, on a special occasion, at Liverpool, one is said to have brought on shore 60 persons.

The maximum, or 36-foot boat, is adapted for such places as

Yarmouth, Lowestoft, Deal, &c., where it is the invariable custom to go off under sail, and where there is never a difficulty in finding beachmen to launch or man the boats, however large. The wrecks at Yarmouth and Deal occur generally on outlying sands; and the boat that happens to be to windward on the coast, according to the direction of the wind, goes off, under canvass, to the wreck. Thus, should a wreck occur on the Yarmouth sands, in a south-east gale, the Pakefield or Lowestoft boat would push off; while in a north-east gale, the Caistor or Corton boat would put to sea. The boats actually in use at these places are from 40 feet to 45 feet long; they weigh from 4 to 5 tons, and cost from £200 to £250 each. They, therefore, form the exception to the general rule; but they are powerful boats, are admirably manned and handled, and have been the means of saving some 300 lives within the last 30 years.

With respect to breadth of beam, in a rapid tideway, as the Tay, the Humber, the Bristol Channel, the shores of the Isle of Man, the Shannon, &c., a boat somewhat of the galley form, but with ends like a whale-boat, would be more suitable than a wider boat. The Tyne boats have a breadth of fully one-third the length, and some more; but such would not seem to be the best proportions: probably as 1 to 3·8, or 8 feet of beam to a length of 30 feet, would best suit the general purposes of a life-boat.

As to depth, it seems only necessary to observe, that a boat that has to be launched through the surf on a beach should not be too shallow in the waist. As a general rule, the free-board, or height of gunwale, from the surface of the water, with crew and gear on board, should not be less than from 22 to 24 inches.

The weight suitable to a life-boat does not seem to have received much consideration from our builders, to judge from the difference in existing boats. Those at Holy Island, at Yarmouth, and Southwold, with their gear, weigh 5 tons; whereas many of the models sent to the Exhibition were said to weigh less than half a ton. The mean between these two extremes will be near the truth. For, however desirable lightness is for transport along a beach, a certain weight of boat is necessary to resist the force of the waves and to retain momentum, so as not to risk being driven back by the sea: under which consideration, 1 cwt. or $1\frac{1}{4}$ cwt. for each foot of length, would be a fair general rule. The weight of gear would vary from 5 cwt. to 15 cwt., according as it comprises oars, masts, sails, anchor, cable, warps, &c.

Whatever be the length of the boat, care should be taken that the space between the thwarts should not be less than from 28 to 30 inches; as in pulling in a seaway it is impracticable always to keep stroke; and if the thwarts are too close, the loom of one man's oar is liable to strike the back of the man abaft him. This is a common complaint in life-boats. The oars should be short, to pull double banked, and of fir, as being lighter, more buoyant, and stiffer than ash, which is too pliable. They should pull with iron thole-pins, having rope grummetts secured to them; and the

pins should be so placed, that the boat may be pulled either way, by the men merely turning round on the thwarts.

Hitherto all our boats have been of wood, but the testimonials in favor of metal boats are very strong. Galvanized iron (if that process prevents oxidation and the action of sulphur from coal-smoke, which does not yet seem to be established) would be the most economical, and the corrugated form of it would give strength. But if metal boats be adopted, copper might be preferred, as more durable and more tractable. The boats in which Lieut. Lynch, of the United States navy, descended the rapids of the river Jordan, in 1848, were of copper; and that officer reports most favorably of them.

In the construction of wood boats, well-seasoned Scotch larch, from its durability and lightness (its specific gravity being little more than double that of cork), would be found the best material; but neither Polish nor Italian larch should be trusted to. American white cedar is both light and durable. One advantage in having wood boats is, that we should have the benefit of the skill of the numerous boat-builders around the coasts,—whereas the building of metal boats is confined to a few hands; and there is an advantage in having a boat built by an experienced man, who designs and executes his own work.

Of gutta-percha, caoutchouc, kamptulicon, and other similar materials, we have no experience that can be relied on.

Extra buoyancy, or that required beyond what the materials used in the construction of the boat will afford, is the characteristic feature of a life-boat, and as such its nature, amount, and distribution, deserve the most deliberate consideration. If sufficient buoyancy can be obtained by cork, it is far preferable to air-cases, as not being liable to accident. There seems reason to believe that a portion of cork may be used under the flat or floor of the boat, so as to reduce the internal capacity, and enable the boat to free herself of water. The only doubt is as to its weight; but cork varies considerably in weight as well as in price: the commonest description of cork, such as used by fishermen as floats for their in-shore nets, does not exceed 12 lbs. weight per cubic foot, and costs about 12s. a cwt.; a heavier sort weights about 15 lbs. per cubic foot. These might be advantageously disposed in the bottom of a boat, covered with gutta-percha or a light casing, to keep the water out of it; and the boat might then bid defiance to accidents; as, thus armed, even if bilged against a rock, she would float.

With respect to air: the great difficulty of rendering vessels permanently air or water-tight, makes them unfit for general use, unless great care and watchfulness be exercised. In those instances in which the air-cases are built into and form part of the boats, it seems doubtful whether any of them can be depended upon for a year; indeed there is reason to believe that there does not exist at this moment a complete air or water-tight case (undetached) in any life-boat that has been six months in use

around the coasts of Great Britain. As to air-cases that are detached, they may be better; but unless in the form of small casks, as in the Liverpool boats, there seems sufficient reason to suspect them all. Metal air-cases offer rather a more reasonable prospect of security; but when a life-boat was laid open in Woolwich Dockyard a few years since, it was found that from corrosion there were several holes, half an inch in diameter, in the copper tubes, supposed to have been air-tight. It has been the practice of Teasdel, an experienced life-boat builder, at Great Yarmouth, to build his detached air-cases of thin boards of willow-wood, which is both tough and light, and to cover them with painted canvass, and this is believed to be the best; or a sheet of gutta-percha between two thin boards might be adopted, according to Forster's process.

The amount of extra buoyancy may be much less than it has hitherto been customary to give in a life-boat. The cubical contents of the air-cases of many existing life-boats, and of a great part of the models sent to the Exhibition, measure from 200 to 300 feet, equivalent to the support of from six to nine tons of dead weight. Now, if only intended for buoyancy to balance the extra weight likely to be put into a life-boat, this amount is unnecessary. The Liverpool life-boat, already alluded to as having, on one occasion, brought on shore 60 persons from a wreck, had not above 60 cubic feet of extra buoyancy: this is too little; but in a 30-foot boat, provided with ample delivering-valves, 100 cubic feet, or the equivalent of three tons, is sufficient extra buoyancy for all general purposes.

The distribution of the extra buoyancy requires great care. As a general rule, it should be placed high in the boat, so as not to affect her stability; but circumstances require this rule to be slightly modified. In order to reduce the internal capacity of the boat, that she may rise under the weight of a heavy sea that may fall on board, and to enable the delivering-valves to act freely, a certain amount of space should be occupied under the flat or floor of the boat, so as to exclude the water; and the question is, so to fill this space with a material of less specific gravity than water, yet sufficiently heavy to ensure the boat's stability when the flat or flooring is laid at from 10 to 12 inches above the keelson, or about the water-line of intended immersion;—thus acting generally as ballast, but on emergency as extra buoyancy. From the various plans adopted, this would seem the most difficult problem to solve in the whole arrangements of a life-boat. In some existing life-boats, and in many of the models sent in, reduction of internal capacity is attempted by placing a tight deck, fore and aft, at from 16 to 18 inches, and even in some at 24 inches, above the keelson, with only air beneath: the result is, that the weights in the boat raise her centre of gravity, and there is a risk of her upsetting when a sea is shipped. Some of the models thus fitted, on being tested as to their stability, went over directly. Other builders, foreseeing this

result, added an iron keel to their boats ; while some inserted a well or tank amidships for water-ballast, which, as long as it remained in its place, compensates for the amount of air under the flat, and restores the equilibrium. But, although conceding full merit to water-ballast, a portion of cork is considered better, and it may be placed in a water-tight case, or in a gutta-percha covering under the deck, up to about 12 inches in height above the keelson, and combine the properties of ballast generally, with extra buoyancy in case of need. If, above all, a light water-tight deck be placed, the cork will be preserved, and very little water will remain to inconvenience the crew or passengers.

The next point to attend to, in the distribution of the extra buoyancy, is to place the requisite amount of air-vessels in the head and stern-sheets of the boat, from the floor up to the gunwale height, in order to give self-righting power ; always taking care to leave access to within three and a half or four feet of the stem and stern-post, to enable a man to stand there and receive people from the wreck ; as it commonly occurs that a boat cannot go alongside a stranded vessel, but has to receive the rescued men either over the head or stern of the boat. Air-cases should also be placed along the sides of the boat, fore and aft, under the thwarts, to diminish the internal capacity, and to keep the water that may be shipped away from the sides of the boat, and to lead it direct to the delivering tubes. Whenever air-cases are used, it is recommended that they be made detached from the boat, so that they may be examined to test if they are water-tight. They should also have valves inserted in them, as, sooner or later, they are sure to leak : the valves, too, would enable the cases to be aired, and thus preserve them better.

In order to efficiency, every life-boat should be provided with the means of freeing herself rapidly of any water she may ship. By means of sufficient delivering-valves or tubes, led through a platform or flat laid a little above the level of the water-line, there seems no reason why the water, when shipped, should not be carried off rapidly. The area of the valves or tubes should be not less than one square inch for each cubic foot of capacity ;—more would be better. A question may arise, whether it is better that the boat should free herself by tubes through the bottom, or by scuppers in the sides, as shewn in several of the models : the former is the more direct and quickest action ; but the tubes are liable to be choked in the possible case of a boat grounding on an outlying sand-bank, or on the bar of a river harbour ;—it will be better, therefore, to be provided with both, to meet such an accident. The tubes and scuppers should be closed by self-acting valves ;—a modification of an apparatus, known as Kingston's valve, might answer the purpose, or, still better, Wells' disc valve.

The power of self-righting is a contested point among the best boat-builders ; but they seem hardly to have given the subject full consideration. The accidents that have happened to life-boats have not been carefully investigated, and the necessity for meeting

these accidents with a remedy has not forced itself upon their minds. But a remedy is necessary. Recent and sad experience has shewn, that a life-boat may be upset, and may drown the crew from want of being able to right herself.

Most life-boats have good sheer of gunwale, and, consequently, raised extremities, in which air-cases should be placed, in order that, when the boat is bottom upwards, their buoyancy may co-operate most effectually with the weights in the bottom of the boat (now raised, it may be, considerably out of the water), to restore her to her originally upright position. The higher the centre of gravity of a vessel or boat is above the centre of buoyancy, *ceteris paribus*, the less is her stability; and, by the separation of these two centres, a condition of instability will ensue; the effect of which will be, that with the slightest motion, the boat will reverse her position, or right herself. To determine the necessary extent of separation of these centres, in each case, involves careful calculation. The best mode of applying this principle will readily occur to most boat-builders. The objections to the raised air-cases at each end are, the wind they hold in pulling off a lee-shore, and the obstacle to approaching the stem and stern of the boat: the latter may be modified—the former must be tolerated for the greater benefit, in another respect, that arises from their adoption.

It was noticed, as a singular fact, that this property of self-righting, which, when recently proposed as one of the requisites of a good life-boat, was almost treated with derision by some of our best boat-builders, should have been acknowledged and publicly exhibited at Leith, by the Rev. James Bremner, of Walls, Orkney, as far back as July, 1800.

A necessary adjunct to a life-boat is a carriage for transporting it alongshore, or, when the tide is out, for carrying the boat down to the water, and launching it, without risk, into the sea. The building a good carriage is a problem not easily solved. Among the many models of carriages sent to the Exhibition, not one exactly fulfils the conditions which appear essential. The carriage should combine lightness with strength, to carry at least 40 cwt. in case of need. The boat should be supported as near the ground as may be, so that it does not risk striking the bottom in going over a rocky beach; the wheels should be of large diameter, for facility in moving, with broad tires, to prevent their sinking into the sand.

The lecturer then referred to some of the principal accidents which had occurred to life-boats, and concluded his remarks by saying, that there seems no reason why a very few years should not see a life-boat stationed at each of the exposed points on the most frequented parts of the coasts of the United Kingdom: by means of which—with the blessing of Divine Providence upon the endeavours of those who undertake the work—the best results to the cause of humanity may confidently be anticipated.

List of Patents

That have passed the Great Seal of IRELAND, from the 17th February to the 17th April, 1852, inclusive.

To Hermann Turck, of Broad-street-buildings, in the City of London, merchant, for improvements in the manufacture of rosin oil,—being a foreign communication.—Sealed 24th February.

George Gwynne, of Hyde-park-square, in the county of Middlesex, Esq., and George Fergusson Wilson, Managing Director of Price's Patent Candle Company, of Belmont, Vauxhall, for improvements in treating fatty and oily matters; and in the manufacture of lamps, candles, night-lights, and soap.—Sealed 24th February.

William Jean Jules Varillat, of Rouen, in the Republic of France, for improvements in the extraction and preparation of coloring, tanning, and saccharine matters from various vegetable substances, and in the apparatus to be employed therein.—Sealed 15th March.

Charles Middleton Kernot, of West Cowes, in the Isle of Wight, M.D., and William Hirst, of Manchester, in the county of Lancaster, manufacturer, for certain improvements in the manufacture of woollen cloth, and cloth made from wool and other materials; and in machinery or apparatus for manufacturing the same.—Sealed 15th March.

Henry Glynn, of Burton-street, Berkeley-square, Gent., and Rudolph Appel, of Gerrard-street, Soho, anastatic printer, for improvements in the manufacture or treatment of paper or fabrics, to prevent copies or impressions being taken of any writing or printing thereon.—Sealed 16th March.

John Wormald, of Manchester, in the county of Lancaster, maker-up and packer, for certain improvements in machinery or apparatus for spinning and doubling cotton, wool, silk, flax, or other fibrous substances.—Sealed 16th March.

Sir John Scott Lillie, of Pall Mall, in the county of Middlesex, Companion of the most Honorable Military Order of the Bath, for certain improvements in the construction and covering of roads, floors, walls, doors, and other surfaces.—Sealed 16th March.

Thomas Barnett, of the town of Kingston-upon-Hull, in the county of York, grocer, for certain improvements in machinery for grinding wheat and other grain.—Sealed 22nd March.

Alexander Hediard, of Rue Taitbout, Paris, France, Gent., for certain improvements in rotary steam-engines.—Sealed 31st March.

Russell Sturgis, of No. 8, Bishopsgate-street, in the City of London, merchant, for improvements in weaving looms,—being a foreign communication.—Sealed 31st March.

Henry Bernoulli Barlow, of Manchester, in the county of Lancaster, consulting engineer and patent agent, for improvements in preparing and dressing hemp and flax, and in the machinery employed therein,—being a foreign communication.—Sealed 5th April.

List of Patents

Granted for SCOTLAND, from the 22nd March to the 22nd April, 1852.

To Richard Archibald Brooman, of Fleet-street, London, Gent., for improvements in presses and pressing, in centrifugal machinery, and in apparatus connected therewith,—part or parts of which are applicable to various useful purposes,—being a communication.—Sealed 24th March.

Colin Mather, of Salford, machine-maker, and Ernest Rolffs, of Cologne, Prussia, for certain improvements in printing, damping, stiffening, opening, and spreading woven fabrics.—Sealed 24th March.

Alexander Forfar, of Milnathort, Kinrossshire, builder, for improvements in ventilation, and in the prevention of smoky chimneys.—Sealed 29th March.

James Melville, of Roebank Works, Lochwinnoch, Renfrewshire, for improvements in weaving and printing shawls and other fabrics.—Sealed 29th March.

Joseph Jones, of Bilston, furnace builder, for certain improvements in furnaces, used in the manufacture of iron.—Sealed 29th March.

Sir John Scott Lillie, of Pall Mall, London, for certain improvements in the construction or covering of walls, floors, roads, footpaths, and other surfaces.—Sealed 2nd April.

William Watson Pattinson, of Felting New House, Gateshead, manufacturing chemist, for improvements in the manufacture of chlorine.—Sealed 2nd April.

George Mills, of Southampton, engineer, for improvements in steam-engines, boilers, and in steam propelling machinery.—Sealed 2nd April.

Alexander Hediard, of Rue Taitbout, Paris, for certain improvements in rotatory steam-engines.—Sealed 5th April.

Joseph Pimlott Oates, of Lichfield, surgeon, for certain improvements in machinery for manufacturing bricks, tiles, quarrice, drain-pipes, and such other articles as are, or may be, made of clay, or other plastic substance.—Sealed 6th April.

Russell Sturgis, of No. 8, Bishopsgate-street, London, merchant, for improvements in weaving looms,—being a communication.—Sealed 8th April.

Richard Archibald Brooman, of Fleet-street, London, Gent., for certain improvements in the preparation and treatment of fibrous and membranous materials, both in the raw and manufactured state; in applying electro-chemical action to manufacturing purposes; and in the manufacture of saline and metallic compounds,—being a communication.—Sealed 10th April.

Thomas Barnett, of Kingston-upon-Hull, grocer, for improvements in machinery for grinding wheat and other grain.—Sealed 13th April.

Charles William Siemens, of Birmingham, engineer, for an improved fluid-meter,—being partly a communication.—Sealed 15th April.

William Whitaker Collins, of Buckingham-street, Adelphi, London, engineer, for certain improvements in the manufacture of steel,—being a communication.—Sealed 16th April.

Richard Roberts, of Manchester, engineer, for improvements in machinery or apparatus for regulating and measuring the flow of liquids; also for pumping, forcing, agitating, and evaporating fluids; and for obtaining motive power from fluids.—Sealed 16th April.

John Flack Winslow, of the City of Troy, State of New York, iron-master, for improvements in machinery for blooming iron.—Sealed 16th April.

William Hyatt, of Old-street-road, London, engineer, for improvements in obtaining and applying motive power.—Sealed 19th April.

Martyn John Roberts, of Woodbank, Gerrards Cross, Bucks, for improvements in galvanic batteries, and in obtaining chemical products therefrom.—Sealed 19th April.

François Joseph Beltzung, of Paris, engineer, for improvements in the manufacture of bottles and jars, of glass, clay, gutta-percha, or other plastic material; and caps and stoppers for the same; and in pressing and moulding the said materials.—Sealed 19th April.

John Walter de Longueville Giffard, of Serle-street, Lincoln's Inn, Barrister at Law, for improvements in fire-arms and projectiles.—Sealed 19th April.

William Gorman, of Glasgow, in the county of Lanark, North Britain, engraver, for improvements in obtaining motive power; which improvements, or parts thereof, are applicable for measuring and transmitting aeriform bodies and fluids.—Sealed 20th April.

New Patents**SEALED IN ENGLAND.**

1852.

To James Melville, of Roebank Works, Lochwinnoch, in the county of Renfrew, North Britain, calico printer, for improvements in weaving and printing shawls and other fabrics. Sealed 29th March—6 months for enrolment.

James Timmins Chance, of Handsworth, in the county of Stafford, glass manufacturer, for improvements in the manufacture of glass. Sealed 29th March—6 months for enrolment.

Charles Jack, of Tottenham-court-new-road, for improvements in machinery for grinding pigments, colors, and other matters. Sealed 29th March—6 months for enrolment.

John Whitehead, of Holbeck, in the parish of Leeds, in the county of York, machine manufacturer, for improvements in machinery for preparing, combing, and drawing wool, silk, cotton, and other fibrous substances. Sealed 29th March—6 months for enrolment.

John Flack Winslow, of the City of Troy, in the State of New York and United States of America, iron-master, for improvements in machinery for blooming iron. Sealed 31st March—6 months for enrolment.

Moses Poole, of the Patent Office, London, Gent., for improvements in fire-arms,—being a communication. Sealed 31st March—6 months for enrolment.

William Earnshaw Cooper, of Mottram, in the county of Chester, tallow chandler, for certain improvements in the manufacture of candles and candle wicks, and in the machinery or apparatus employed therein. Sealed 2nd April—6 months for enrolment.

Joseph Pimlott Oates, of Lichfield, in the county of Stafford, surgeon, for certain improvements in machinery for manufacturing bricks, tiles, quarries, drain pipes, and such other articles as are, or may be, made of clay or other plastic substance. Sealed 6th April—6 months for enrolment.

Samuel Fox, of Stocks Bridge Works, Deepcar, near Sheffield, for improvements in umbrellas and parasols. Sealed 6th April—6 months for enrolment.

William Watson Pattinson, of Felling New House, Gateshead, manufacturing chemist, for improvements in the manufacture of chlorine. Sealed 6th April—6 months for enrolment.

Moses Poole, of the Patent Office, London, Gent., for improvements in covering wires for telegraphic purposes,—being a communication. Sealed 6th April—6 months for enrolment.

John Walter de Longueville Giffard, of Serle-street, Lincoln's-Inn, Barrister at Law, for improvements in fire-arms and projectiles. Sealed 6th April—6 months for enrolment.

François Joseph Belzung, of Paris, engineer, for improvements in the manufacture of bottles and jars, of glass, clay, gutta-percha, or other plastic material; and caps and stoppers for the same; and in machinery for pressing and moulding the said materials. Sealed 15th April—6 months for enrolment.

Charles William Siemens, of Birmingham, in the county of Warwick, engineer, for an improved fluid-meter,—being partly a communication. Sealed 15th April—6 months for enrolment.

Edwin Pettitt, of Kingsland, in the county of Middlesex, civil engineer, and James Forsyth, of Caldbeck, Cumberland, spinner, for improvements in machinery for twisting, drawing, doubling, and spinning of cotton, wool, silk, flax, and other fibrous substances. Sealed 15th April—6 months for enrolment.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements for preventing the incrustation of steam-boilers; which invention is also applicable to the preservation of metals and wood,—being a communication. Sealed 15th April—6 months for enrolment.

Charles Seely, of the City of Lincoln, for improvements in the manufacture of flour. Sealed 15th April—6 months for enrolment.

Thomas Ellwood Horton, of Priors Lee Hall, in the county of Salop, iron-master, and Elisha Wylde, of Birmingham, engineer, for improvements in apparatus for heating and evaporating. Sealed 15th April—6 months for enrolment.

Simon Davey, of Rouen, France, merchant, and Adolphe Ludovic Chanu, of Paris, France, merchant, for improvements in explosive compounds and fuses; and also in methods of firing the same. Sealed 15th April—6 months for enrolment.

Henry Gustave Delvigne, of Brixton, in the county of Surrey, Gent., for certain improvements in fire-arms, and in the methods of discharging the same; also improvements in projectiles. Sealed 17th April—6 months for enrolment.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in machinery or apparatus for cutting paper, paste-board, or other similar substances,—being a communication. Sealed 17th April—6 months for enrolment.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, civil engineer, for improvements in the method of, and apparatus for, indicating and regulating the heat and the height, and supply of water in steam boilers; which said improvements are applicable to other purposes, such as—indicating and regulating the heat of buildings, furnaces, stoves, fire-places, kilns, and ovens, and indicating the height and regulating the supply of water in other boilers and vessels. Sealed April 17th—6 months for enrolment.

CELESTIAL PHENOMENA FOR MAY, 1852.

D. H. M.		D. H. M.	
1	Clock after the ☉ 3m. 5s.	16	Ceres, R. A., 7h. 44m. dec. 1
—	☽ rises 4h. 1m. A.	—	38. N.
—	☽ pass mer. 10h. 16m. A.	—	Jupiter, R. A., 15h. 1m. dec.
—	☽ sets 3h. 54m. M.	—	15. 50. S.
9 48	☿ in conj. with ♄ diff. of dec.	—	Saturn, R. A., 2h. 32m. dec. 2
	2. 26. N.	—	43. N.
21 32	♄ in the descending node.	—	Uranus, R. A., 2h. 14m. dec. 2
3 10 23	Ecliptic oppo. or ☉ full moon	—	59. N.
3 17 37	♄ in conj. with the ☽ diff. of dec.	—	Mercury pass mer. 22h. 34m.
	2. 50. S.	—	Venus pass mer. 3h. 11m.
23	☽ in Perigee	—	Mars pass mer. 5h. 40m.
4 8 19	♄'s second sat. will em.	—	Jupiter pass mer. 11h. 21m.
5	Clock after the ☉ 3m. 30s.	—	Saturn pass mer. 22h. 50m.
—	☽ rises 9h. 44m. A.	—	Uranus pass mer. 22h. 33m.
—	☽ pass mer. 1h. 3m. M.	1 36	♄'s first sat. will em.
—	☽ sets 5h. 36m. M.	15 28	♄ in conj. with the ☽ diff. of dec.
—	Occul. B.A.C., 6343, im. 13h. 21m.		4. 26. N.
	em. 14h. 10m.	16 14	☿ in conj. with the ☽ diff. of dec.
6	Occul. B.A.C., 6161, im. 15h. 35m.		1. 29. N.
	em. 16h. 48m.	17 1 35	♄ in conj. with the ☽ diff. of dec.
7 3 6	♄'s first sat. will im.		2. 22. N.
8 7 46	♄ in oppo. to the ☉	8 5	♄'s first sat. will em.
10	Clock after the ☉ 3m. 50s.	10	☽ in Apogee
—	☽ rises 1h. 32m. M.	19 3 15	Ecliptic conj. or ☉ new moon
—	☽ pass mer. 5h. 45m. M.	20	Clock after the ☉ 3m. 44s.
—	☽ sets 10h. 5m. M.	—	☽ rises 5h. 3m. M.
11 23	☽ in ☐ or last quarter	—	☽ pass mer. 1h. 5m. A.
11 46	☿ in conj. with ♄ diff. of dec.	—	☽ sets 9h. 17m. A.
	2. 43. S.	1 51	♄'s third sat. will em.
11 16 36	☿ greatest elong. 45. 23. E.	22 13 6	☿ in conj. with the ☽ diff. of dec.
21 53	☿ stationary		2. 15. N.
12 1 22	☿ in Aphelion	23 3 30	♄'s first sat. will em.
26	♄'s second sat. will em.	24 9 59	♄'s first sat. will em.
9 53	♄'s third sat. will em.	25	Clock after the ☉ 3m. 20s.
14 23 30	☿ in conj. with ♄ diff. of dec.	—	☽ rises 9h. 38m. M.
	2. 43. S.	—	☽ pass mer. 5h. 32m. A.
15	Clock after the ☉ 3m. 54s.	—	☽ sets 0h. 40m. M.
—	☽ rises 8h. 20m. M.	1 4	☿ in conj. with the ☽ diff. of dec.
—	☽ pass mer. 9h. 24m. M.		2. 5. S.
—	☽ sets 3h. 41m. A.	19 9	☿ in conj. with ♄ diff. of dec.
16	Mercury, R. A., 2h. 14m. dec.		1. 27. S.
—	10. 11. N.	26 3 38	☽ in ☐ or first quarter
—	Venus, R. A., 6h. 40m. dec. 26.	22 30	☿ greatest elong. 24. 33. W.
—	9. N.	27	Occul. γ, Virginia, im. 7h. 14m.
—	Mars, R. A., 9h. 17m. dec. 17.		em. 7h. 44m.
—	31. N.	29	Occul. 80, Virginia, im. 8h. 18m.
—	Vesta, R. A., 1h. 4m. dec. 1.		em. 9h. 27m.
—	1. N.	30 22 6	♄ in conj. with the ☽ diff. of dec.
—	Juno, R. A., 23h. 2m. dec. 0. 9. S.		3. 8. S.
—	Pallas, R. A., 6h. 12m. dec. 0.	31 11 53	♄'s first sat. will em.
	7. N.		

J. LEWTHWAITE, Rotherhithe.

THE
LONDON JOURNAL,
AND
REPERTORY
OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXLVI.

RECENT PATENTS.

To ANTOINE PAUWELS, of Paris, in the Republic of France, merchant, and VINCENT DUBOCHET, also of Paris, in the Republic of France, merchant, for certain improvements in the production of coke, and of gas for illumination; and also in regulating the circulation of such gas.—[Sealed 23rd April, 1850.]

THIS invention has for its object, first, to extract from pit-coal a gas fit for illumination, and to produce, at the same time, a quality of coke possessing all the properties requisite for smelting metals and generating steam in locomotives; and, secondly, to regulate the pressure of the gas in the passages of the apparatus, according to circumstances, so as to render the loss of gas as small as possible. These results are obtained by means of a "pyrotechnic apparatus," with its "extractor" and a "moderator."

The pyrotechnic or coking apparatus is represented in Plate XII., at figs. 1, 2, 3, and 4;—fig. 1, being a vertical section thereof; fig. 2, another vertical section, taken on the line 1, 2, of fig. 1; fig. 3, a horizontal section, on the line 3, 4, of fig. 1; and fig. 4, another horizontal section, on the line 5, 6. *a, a*, are the fire-places, below which are flues *c*; by means whereof, and of the registers *p, p*, the caloric produced in the fire-places *a*, is caused to circulate at pleasure, either under the ovens in operation, or directly towards the large chimney *b*. *c'*, are orifices for cleaning the flues *c*. Above the fire-places is the bed *d*, of the oven, made of fire-brick; and from this bed rises a wall (made, by preference, of an elliptical form), from the top of which springs the arch or

dome *e*: these together form the oven. *f, f*, are two openings for feeding in the coal and discharging the coke, provided with moveable sliding doors. The coal might, however, be fed in through the opening or chimney *g*, by means of tilt-carts, running on a railway above the ovens, or in any other manner suited to the locality. In the centre of the dome *e*, is the lower end of the chimney *g*, which is made of fire-brick, and is enclosed in a cast-iron pipe *h*; and at the top of this pipe is another, also of cast-iron, having three openings *i*. The largest of these openings is furnished with a stopper or cover, and is intended to facilitate the cleansing of the two pipes *j*, that lead to the hydraulic valves *k*, (for which, slide-valves might be substituted), communicating with the pipes *s*, for extracting the gas: these pipes communicate with the regulator of the extractor. The upper orifice of the chimney *g*, is arranged in such manner that it may be closed by means of a stopper or cover during the process of distillation, and may be furnished with a pipe *m*, during the process of carbonization. This pipe *m*, is intended to put the chimney *g*, in communication with the vertical pipe *n*, and the horizontal flue *o*, and, by means of the registers *p*¹, and *p*, with the flues underneath the bed of the oven, so as to conduct the combustible gases at pleasure beneath other ovens, which are required to be heated, and, finally, by the register *b*¹, to the exit-chimney *b*. It will be seen, on referring to fig. 1, that the top of the chimney *g*, is furnished with two gas-pipes *j, j*, having hydraulic valves *k*, and their pipes *s*. By means of this arrangement, in duplicate, if a double extractor were employed, continuous operation might be ensured, in case one of the extractors should momentarily cease to work. *q, q*, represent the solid portions of the oven, composed of incombustible materials, such as bricks and sand, resting on the dome *e*, and surrounded on all sides by brick-work, and serving as a reservoir for caloric. *t, t*, fig. 4, are small openings or passages, to facilitate cleaning, and to allow of the air entering under the bed of the ovens, in order to effect the combustion of the gases.

The object of the extractor is to protect the pyrotechnic apparatus from atmospheric pressure. It is divided into three distinct parts. The first is composed of three vats, full of water, in which three bells or moveable chambers are caused to work up and down by any convenient motive power, made to act upon suitable shafts and cranks. The second part of the apparatus consists of two large cylinders, provided with rectangular plungers, united together, and acting as valves,

which constitute, with the first part of the mechanism, an aspirating and forcing apparatus,—the action whereof is regulated by the third portion of the apparatus, consisting of a large vat, in which a bell or moveable chamber, something like a gasometer, works. The office of this latter is to regulate and maintain the equilibrium of the pressure.

Fig. 5, is a longitudinal sectional view, taken at three different places of the vats, with their bells or moveable chambers, and the mechanism for actuating the same. Fig. 6, is a transverse section of the vats, bells or chambers, cylinders, and plungers. Fig. 7, is a section of the apparatus which serves to regulate and maintain the equilibrium of the pressure. The vats *a*, being filled with water, or any other liquid, each of the bells or chambers *a*¹, is successively put in motion, in a vertical direction, by means of the mechanism shewn at fig. 5. During this movement, the gas coming from the distilling apparatus through the pipe *s*, (see fig. 6,) enters the cylinder *g*, through the vertical pipe *d*;—the same bell or chamber descending, forces the gas through the pipe *f*, and then down the descending pipe *g*¹, into the body of the cylinder *h*; from which the gas is driven through a pipe (marked *b*, in fig. 7,) connected, at one end, with the extracting apparatus, and, at the other, with the pipe *l*, of the third portion of the apparatus or regulator.

The effect of the alternative action of the three bell-chambers being constantly to suck up a body of gas equal to their capacity, and, on the other hand, the production of the gas being necessarily variable, it is desirable, in order to maintain equilibrium in the aspirative action, to provide the necessary quantity of gas for that purpose. It is also necessary to be able to regulate at pleasure the amount of pressure or vacuum under the influence of which the gas is made to flow. For this purpose, if the distilling apparatus does not produce a quantity of gas corresponding to the capacity of the extractor, the bell-chamber *j*¹, of the regulating apparatus forces into the pipe *b*, the necessary extra quantity of gas, and returns it to the extractor. Thus, even if the production of the gas were to cease, the extractor would be continually supplied by the same gas circulating incessantly through the apparatus. With regard to the degree of pressure under which the gas is desired to be produced, it may be regulated at pleasure by means of a counterweight. In order to obviate any inconvenience which might arise from the accidental stoppage of the extractor, two extractors are provided (one being always

kept in reserve), and attached to the pipes *j, j*, of the pyrotechnic apparatus.

In order to set an oven to work, it (as well as the heat-reservoir) must first be raised to a high temperature, by the application of heat both to the interior and exterior. This being done, the fires in the fire-places *a*, are to be kept up; and, as soon as the coal has been introduced into the oven, the doors must be closed,—leaving, however, the orifice of the chimney *g*, open for a few minutes, to allow the aqueous vapours to escape; after which, the orifice is closed by means of the cover, and the hydraulic valve *k*, at the same time, is opened, to allow the gas to pass through the chimney *g*, and the pipe *j*. The gas is then drawn by the extractor from the oven, and forced into the various apparatus of which the gas-works are composed; and the extractor must be so regulated that its action shall prevent any variation of pressure in the pyrotechnic apparatus and its appendages.

When the coal (submitted to distillation by the action of the heat in the fire-places *a*, and in the heat-chamber *e, g*), ceases to give off carburetted gas, the distillation is stopped. For this purpose, the interior of the oven is cut off from the action of the extractor by closing the hydraulic valve, and, at the same time, substituting the syphon-pipe *m*, for the cover previously applied to the top of the chimney *g*. The external air is then allowed to enter through orifices in the doors *f*, in sufficient quantity to inflame a portion of the gases, which are conducted through the passage *n*, and channels *o*, and *c*, under the oven or ovens to which heat is required to be applied, by means of divers flues and registers, as shewn. When combustion of the non-carburetted gas has taken place, the apparatus must be hermetically closed; and, after the lapse of sufficient time to allow the coke to acquire the consistency necessary for its discharge from the oven, that operation is effected in the ordinary manner, and the coke treated as usual. Another charge of coal is then fed in, and the operation proceeded with as before,—the process of distillation being immediately commenced by the heat accumulated in the heat-chamber *e, g*, aided by the furnaces *a*.

This heat-reservoir, which is composed of incombustible materials, acts as the principal distilling agent, and therefore constitutes one of the features of the present invention. Equal importance is also attached to the small furnaces below, and to the system of flues for conveying, as required, either the heat arising from the furnaces, or from the carbonization.

The above operation may be divided into four distinct

parts, viz., first, the expulsion of the aqueous products through the chimney of extraction; second, the extraction of the carburetted gas, by the distillation of the coal by means of the caloric accumulated in the flues and the surrounding mass of brickwork or masonry, and also of the small furnaces; third, the final carbonization of the coal, by the combustion of a portion of the non-illuminating gases, which raises the whole apparatus to the degree of temperature necessary for effecting the distillation of a fresh charge of coal; and, lastly, leaving the apparatus closed and in repose, in order that the coke may, while in a state of incandescence, acquire the solidity necessary for its discharge from the oven.

From what has been stated, both with regard to the pyro-technic apparatus and the extractor, it will be seen that they cannot be employed separately, as their combination forms the principle feature of the invention,—which has for its object the obtaining of hard coke, and also gas fit for illuminating purposes, simultaneously from the same charge of coal. When it is not desirable, however, to obtain the gas for illumination, it may be utilized in the manner above indicated for the non-carburetted gas: in this case, the extractor not being necessary, the oven must, directly after the coal is fed in, be put in communication, by means of the bent pipe *m*, with the flues *n*, *o*, and *c*; whereby the gas or caloric is conducted under the bed of the other oven or ovens, as above described, for the purpose of heating them. In order to effect perfect combustion of the gases, a suitable quantity of air must be conveyed under the bed of the ovens. The draft-chimney may be employed to draw off the gases from the interior of the ovens, instead of the extractor; and the extractor may be made to convey the whole of the gases under the bed of the ovens.

The moderator is composed of a valve, for regulating the flow of the gas; a float, which gives motion to the mechanism by the action of the gas; a counterweight, for regulating the degree of pressure under the influence of which the gas is made to flow; and a metal casing, that encloses the whole of these parts. Fig. 8, is a vertical and fig. 9, a horizontal section of this apparatus. *a*, is the entrance-pipe, for the gas; *b*, exit-pipe; *c*, a cover; *d*, a casing, in which the valve *h*, works; *e*, bell or floating chamber; and *f*, is a vibrating rod or beam, supporting, at one end, the bell-chamber, by means of a chain *g*, and connected at the other by chains or rods to the rod *i*, of the valve *h*. The valve *h*, is composed, firstly, of the wings, which are made, by preference, of a rect-

angular form, and mounted loosely upon suitable bearings; secondly, of the frame *d*, (in which the wings work), made with two cheeks *s*, *s*, which are set in the pipe *a*, and in a portion of the space *m*: the wings, in their movement, are always in contact with the cheeks *s*. There are also two pieces *d*¹, *d*¹, fixed above and beneath upon the framing *d*, in opposite positions. A small hole is made in the lower one, to allow the water of condensation to run off.

The "float apparatus" is composed of a metal bell-chamber *e*, contained in a metal tank *k*, which is of a circular form, and is furnished on one side with a chamber, for the reception of the counterweight *n*; and the tank and its chamber are both partly filled with water. To the tank are adapted the two pipes *a*, and *b*; and the whole is surmounted by the cover *c*. The bell-chamber *e*, has a central pipe *r*, extending up through it from top to bottom, and serving as a sheath for the pipe *j*, which communicates with the atmosphere; and, at the top of the pipe *r*, there are small holes, to allow of the escape of any air which might find its way between the water and the top of the bell-chamber. In order to prevent the too sudden action of the valve *h*, the air can only find its way through these holes to or from the bell-chamber *e*: this is the method which the patentees prefer; although the same effect might be obtained by diminishing the size of the orifice of the pipe *j*. This pipe branches off at its lower extremity into two parts, one of which rises to the surface of the ground, and terminates in a cock *l*, fig. 10; and this cock, by communicating with a manometer *l*, allows the conditions under which the float apparatus is working to be ascertained. Under the boss of the cock *l*, is an orifice *u*, through which the air necessary for the working of the apparatus circulates. A quantity of air, equal to the capacity of the bell, may also be introduced into it by means of a double-valve bellows;—the orifice being then closed by means of a screw-plug, the float will resist any pressure in the capacity *m*; and the gas will then continue to circulate in the same manner as if the moderator did not exist; as, by this means, the action of the moderator upon the gas in the pipes is completely neutralized. The second branch *j*¹, of the pipe *j*, remains underground: its office is to allow any water which may accumulate in the pipe *j*, to run off; and it terminates either in a syphon or a cock *p*, fig. 8. In the latter case, the cock is surmounted by a vertical pipe, rising above the ground, having a suitable plug and handle, by which the cock can be opened and closed. It is indispensable that this cock should be closed when the

float is to be protected from the pressure of the gas, by the introduction of air, as above mentioned. *v, w*, are two cocks, situated one on either side of the cock *l*, and communicating with the main gas-pipe by means of small pipes *x, y*,—the pipe *x*, being in front, and the other *y*, behind the moderator, and being put in communication with the manometer, for the purpose of ascertaining the degree of pressure of the gas before and after entering the moderator. At the level of the pipes *a, b*, there is a circular passage *g*, to allow of the passage of the gas when it is stopped by the rising of the bell-chamber *e*. The counterweight *n*, is composed of discs of metal, mounted on the rod *o*, which is suspended by flexible steel rods or chains from the end of the beam *f*. It is so arranged that the counterweight shall act entirely below the lower level of the pipe *a*, and that, on coming in contact with the bottom of the chamber, it shall prevent the further rise of the bell-chamber *e*.

The application of the moderator is as follows:—The pipe *a*, is under the influence of an unregulated pressure. The valve *h*, determines, according to its position, the size of the orifice through which the gas flows. The interior space *m*, behind the valve, contains the gas, the pressure of which is regulated, and which flows through the pipe *b*. The degree of pressure at which the gas is required to flow is regulated by the rise of the float or bell-chamber *e*; and this rise is regulated by the action of the counterweight adapted to one arm of the beam *f*,—the float or bell-chamber *e*, being in communication with the atmosphere by means of the pipe *j*. In the position in which this apparatus is shewn at fig. 8, the pressure of the gas contained in the space *m*, is supposed to be greater than the tendency of the float to rise. In this position, the valve *h*, will prevent the entrance of any more gas until the pressure of that contained in the space *m*, diminishes: the float will then be allowed to rise, and the valve *h*, opened to the required extent. If, on the contrary, the pressure increases, the float will be caused to descend, and, by closing the valve *h*, prevent the entrance of the gas. It is evident that, by this means, a uniform degree of pressure may be obtained, whatever may be the variations in the flow of the gas. The gas does not enter the bell-chamber *e*, which is in communication with the atmosphere, but only acts upon its exterior. The waters of condensation, which are found in the main pipes, are not prevented from flowing along the pipes: they even serve to supply the tank *k*, with water.

The apparatus above described is more especially intended

to be employed underground; but it may, by means of the following modifications, be made susceptible of a more general application, and be made to act with greater precision in hotels, theatres, and other establishments which are lighted by gas, both for the purpose of protecting the burners from the variations of external pressure, and also to prevent fraud in the consumption of the gas, by limiting the supply of gas to the burners by means of a regulating valve.

The first modification is shewn, in vertical section, at fig. 11. The difference between this apparatus and that above described, consists, firstly, in setting the entrance and discharge-pipes for the gas at different levels; secondly, the valve *h*, instead of being mounted horizontally in the induction-pipe, as in the former instance, is in the form of a parabolic cone, and is mounted above, and caused to rise and fall on, a seat directly over the bell-chamber or float; and, lastly, the counterweight *n*, works in a chamber isolated from the tank containing the float. The same letters are marked upon corresponding parts, as in the former arrangement, excepting that *d*, represents the seat for the conical valve;—*h*, is the conical valve; *i*, the chamber for the counterweight; and *a*¹, the space occupied by the gas which has not been regulated.

Fig. 12, represents a vertical section of the second modification, in which a helical or other suitable spring is substituted for the balance-beam and counterweight of the former apparatus. *a*, is the entrance-pipe, and *b*, the exit-pipe, for the gas; *e*, is the float or bell-chamber, working in a tank *k*; and *f*, the helical spring above the conical regulating valve *h*, which rises and falls on a valve-seat *d*. *j*, is a pipe, for the entrance of air to the bell-chamber *e*, furnished with a cock *p*; and *a*¹, is a chamber, for receiving the gas before it is regulated. *m*, is a chamber, into which the gas passes, and in which the pressure of the gas is regulated; *n*, is a valve, for regulating the exit of gas; and *o*, an entrance-cock. In this modification, a fluid of great density, such as mercury, must be employed instead of water.

The patentees claim, First,—the pyrotechnic apparatus above described, constructed with one or more fire-places or furnaces, and with a caloric reservoir, or arrangement of parts for storing the heat, and also an arrangement of flues for the circulation and distribution of the caloric;—the said apparatus having for its object the simultaneous production from coal of carburetted gas, suitable for illumination, and of coke, of suitable quality for the purposes of smelting metal and generating steam in locomotive engines,—such operations being

effected by the employment of the waste gases, or of all the gases, if coke only is required to be produced. Secondly,—the application, to the pyrotechnic apparatus, of the extractor,—its object being to protect the oven from the pressure of the atmosphere, and to draw off and collect the gas, either for the purpose of illumination, or to serve as fuel to the furnaces of the pyrotechnic apparatus, as above described and shewn. Thirdly,—the apparatus called the moderator, for regulating the flow and distribution of the gas, as above described and shewn.—[*Inrolled October, 1850.*]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in refining gold,—being a communication.—[Sealed 22nd August, 1850.]

THE subject of this invention is a novel method of separating silver and other impurities from gold bullion,—being an improvement in the art of refining gold for coinage and other purposes.

The present mode of refining gold bullion consists, in part, of the operation of quartation, as it is called,—that is, of melting and intimately combining with the gold bullion, from two to three times its weight of silver. To extract this silver, together with all the impurities originally contained in the gold bullion itself, it requires that it should be granulated, by pouring it, while molten, into water; and, subsequently, that it should be digested, either in sulphuric acid, concentrated to 66° Baumé, at the boiling temperature thereof,—costly platinum vessels being employed for the purpose: or the digesting operation may be effected by submitting it to nitric acid, of 36° Baumé, at temperatures not lower than 212° Fahr., or the boiling point of water,—fragile vessels of glass, porcelain, or earthenware, being employed in this case.

The advantages attained by the present invention are,—first, the comparative easy separation from gold bullion of the impurities with which it is in combination, without using silver for quartation, and, consequently, preventing the waste of silver, and the necessity of using costly apparatus; second, a great economy of time, labor, and expense is effected; third, the saving of interest of capital sunk in carrying on the operation of refining, as conducted by the old processes; fourth, the use of lower temperatures than in the ordinary methods,

and the employment of vessels of lead, which are not subject to fracture; fifth, the rendering the work of the refiner more simple, expeditious, and free from the necessity of his constant attention, less injurious to his health, and no longer a nuisance to the neighbourhood, if conducted in densely populated places.

The invention consists in bringing gold bullion, containing silver or other impurities, into a loose, divided, pulverulent, or spongy state, texture, or disintegrated molecular condition, so that all the impurities it may contain can readily be removed by acids. The obtaining of gold in such a state, or reducing it from a compact to a disintegrated condition, so that it may be attacked by acids, forms no part or object of the methods now in use; and it is this preliminary mechanical operation which gives to the present improvement in the art of refining gold, the great advantage of dispensing with the use of large quantities of silver; thus causing economy in labor, time, and expense.

The gold bullion to be refined may be of any quality. The first, or preparatory operation, is to make an adulterated alloy or mixture, by melting and mechanically stirring the gold bullion with a sufficient quantity of zinc (usually two or three times the weight of the gold bullion); and, after the melted alloy has been well stirred, it is granulated, by pouring it into water, according to the usual methods.

Secondly. The granulated alloy is treated, in wooden vats lined with lead, with dilute sulphuric acid, which removes the zinc employed for adulteration, and leaves impure or argenteous gold in a finely-divided pulverulent or spongy state, or in a disintegrated molecular condition. The hydrogen which escapes during this operation should be conducted by wooden or other pipes into the open air. In this second operation, heat is not used or required; and no more acid is employed than will combine with the quantity of zinc used for adulteration, and form sulphate of zinc: in other words, the acid is used in atomic proportion. The object sought by the two operations just described is only to operate on the gold bullion in such a manner as to reduce it to a disintegrated or spongy state, in which it shall no longer be capable of resisting or protecting the impurities it may contain from the re-action of acids, as it does when in compact form or consistence.

Thirdly. When the gold bullion has been reduced to a pulverulent or spongy state, by treating an alloy of it with dilute sulphuric acid, all the silver which may have been

originally combined with it it still retains; as dilute sulphuric acid is incapable of extracting any portion thereof. To remove this silver, the disintegrated bullion is digested, as in the methods now employed, either in nitric or sulphuric acid, with heat, and in any suitable vessel.

Finally, the operations are terminated by melting the refined gold with such fluxes as borax, nitre, &c., and casting it into ingots or bars. If the operations have been properly performed, these ingots will be ductile, and of a fineness varying from 98.5 to 99.5 per cent.,—the residual impurity being silver; and the silver extracted from the gold bullion is then to be recovered from its solution in nitric or sulphuric acid by the usual and well-known chemical methods now in use.

For the purpose of explaining the principle which characterizes the present invention, and the several modes in which it is contemplated to apply it in the art of refining gold bullion, the patentee states, first, in reference to the first operation above described, that it may be varied, by melting the gold bullion with a sufficient quantity of some other metal or metals baser than silver, such as iron, copper, &c., to render the alloy base enough for the action of acid in the second operation. Secondly, in reference to the second operation, that it may be varied, by using muriatic, nitric, or other acid, instead of dilute sulphuric acid. Thirdly, that, as the processes, first of alloying and granulating, and, secondly, of treating the alloyed gold bullion with acids, are intended, as above mentioned, only to sufficiently disintegrate that bullion, they may be varied in several ways: thus, for example, if the gold bullion be brittle, or if it be rendered brittle by combining it with small quantities of certain metals, such as lead or solder, then it may be reduced to a finely-divided pulverulent state, or disintegrated molecular condition, by other means, such as grinding or percussion.

The patentee claims, First,—the reduction of argentiferous and other gold bullion, as a preparatory process in the art of refining thereof, into a pulverulent or spongy state, or a disintegrated molecular condition, by the means particularly of fusion therewith, and the subsequent removal by acids therefrom of zinc, or other metal baser than silver which will produce the desired effect, for the purpose of then separating, by means of acids, from such gold bullion, the silver and other impurities which it may contain, in order to fit the gold for coinage and other uses, without quartation with silver, or any intermediate process. Secondly,—in addition to the above processes, the pulverizing, by grinding, crushing, or percus-

sion, of gold bullion, rendered brittle by union with lead, solder, or other like base metal, for the purpose above set forth.—[*Enrolled February, 1851.*]

To ALEXANDER PARKES, of Pembrey, Carmarthenshire, experimental chemist, for improvements in smelting and treating certain metals, and in the construction and manufacture of furnaces, and the materials to be used for the same,—such furnaces and materials being applicable to the treatment of metals and metallic compounds, and to various other useful purposes of a like nature.—[Sealed 11th June, 1850.]

THIS invention consists, firstly, in an improved furnace for calcining the ores and compounds of copper and other metals; secondly, in a mode of separating silver from lead; thirdly, in improved compounds for making bricks, and other articles to be used in the construction of furnaces; and lastly, in the adaptation to furnaces of apparatus for facilitating the combustion of anthracite or stone coal by the employment of numerous jets of steam.

In carrying out the first part of the invention, the patentee builds a circular furnace, of any given dimensions (one of twelve feet diameter is found to be a convenient size), with one or more floors, formed of fire-bricks, laid as evenly as possible—the distance between the floors (when there are more than one) being from three to four feet. In the centre of the furnace a vertical hollow shaft of iron passes through the floors, and carries, at a height not exceeding a foot from each floor, one or more arms, which extend nearly to the outer wall of the furnace; and each arm is furnished with a series of equidistant prongs, that descend to about an inch from the floor. The shaft works on a centre-bearing at the bottom of the furnace, and in a collar at the top; and, by means of wheel-work, or other mechanical arrangement, the shaft is made to revolve slowly, so as to cause the prongs to turn over or agitate the ore or other metallic compound upon the floors of the furnace: it is preferred to complete a revolution in two minutes. The shaft is open at the top, and has several apertures in it, near the bottom, so as to admit of a current of air constantly circulating through it, whereby it is prevented from being damaged by the fire, and is kept cool at the end or axis.

The patentee says, he is aware that others have attempted

to attain the object of this part of the invention by making the floor revolve. What he claims, therefore, is the employment of apparatus revolving over a fixed floor, in order to agitate the mass when undergoing the process of calcination; and he also claims, for such purposes, the use of a hollow shaft of iron, with solid or hollow arms, so constructed as to admit air to pass through them while in motion.

The mode of separating silver from lead, which constitutes the second head of this invention, is as follows:—The lead, containing from 100 to 200 oz. of silver per ton, being in a melted state (by preference, in iron vessels), zinc, also in a melted state, is added thereto, in the proportion of about 1 cwt. thereof to each ton of lead, and the mixture is agitated for a few minutes; after which it is allowed to remain quiet for a short time—being maintained in a melted state, but at as low a temperature as will keep the whole fluid; the heat is next reduced, so as to allow the zinc to crystallize or set, which it will do, combining with the silver, and forming the upper layer of the mass: the combined zinc may then be ladled out with a perforated ladle, or by other means. The above-named quantity or proportion of zinc will combine with a much greater proportion of silver; and therefore the patentee re-melts the zinc alloy, and uses it for de-silvering several quantities of lead, until it is saturated with silver, or nearly so: in this way he has combined from 400 to 500 oz. of silver with the above quantity of zinc. To obtain the silver from the alloy, muriatic or sulphuric acid (by preference, diluted with from four to six times its weight of water) is used to dissolve out the zinc; and the silver, which remains in a metallic state at the bottom of the vessel, may be collected and refined in the usual manner.

The improved compounds for making bricks are applicable to the production of the class known as fire-bricks, or those capable of resisting high degrees of heat. In the preparation of the improved compounds, the patentee uses any natural quartzose substance—preferring those which contain the largest proportion of siliceous matter: such substances should be employed in the state of particles varying from one-eighth of an inch to half an inch in diameter; to obtain which, he usually reduces large pieces or stones by crushing-rollers, or other means, and passes the same through a sieve; and he has found that the larger such particles can be combined together, so as to produce the desired form, the greater heat they will bear without fusion. The patentee mixes with the particles of quartzose substance, in a wet state, from three to ten per

cent. of slaked lime, ground sulphate of lime, or ground sulphate of baryta; and then he moulds, dries, and fires the compound, as in the ordinary way of making bricks: the smaller the proportion of binding substance used, the better will be the result; and the necessary quantity will be decided, in a great measure, by the size of the particles of quartzose substance.

He claims, as the third part of his invention, the combination of the sulphates of lime and baryta, or carbonate or caustic lime, or either of them, with siliceous or quartzose materials, to form bricks and other forms for the above fire purposes—such bricks and other forms being particularly applicable to the construction of furnaces for treating metals, and other useful purposes of a like nature.

The last part of this invention, which has for its object to facilitate the combustion of anthracite or stone coal, consists in certain means of introducing steam into the furnace through iron pipes or apparatus, and dispersing the same, by means of small openings therein, through or upon the coal. The patentee says, he is aware that it has before been proposed to use steam for effecting this object, by means of a pipe or jet. He does not, therefore, claim the use of steam generally, but only the means, hereafter described, of dividing the steam into numerous fine jets, in order that it may be more readily decomposed. The most convenient position to introduce the jets will depend upon the form of the furnace; and the perforated pipes or other apparatus are to be fixed so as to cause the steam to pass through or upon the fire. The patentee prefers to use the steam from a high-pressure boiler, and that it should pass through openings about $\frac{1}{8}$ of an inch in diameter. He has found that the most efficacious plan is to place the perforated pipes parallel with, and beneath the fire-bars, so that the steam may impinge upon the coal through the bars: the pipes, which are placed from 3 to 4 inches apart, have apertures formed in them at about every 6 inches of their length; and there is a cock or valve on the steam-supply-pipe to regulate the flow of steam through the apertures. This part of the invention is not confined to furnaces for treating metal and metallic compounds, but is applicable to furnaces for other useful purposes, and particularly to steam-boiler and other evaporating furnaces.—[Enrolled December, 1850.]

To ALEXANDER PARKES, of Birmingham, for improvements in separating silver from other metals.—[Sealed 24th June, 1851.]

THIS invention consists, firstly, in improvements in the method of employing zinc for separating silver from lead; and secondly, in improvements in afterwards separating the silver from the alloy of zinc and other metals produced by the first process.

In the specification of a former patent, granted to the patentee June 11th, 1850,* he described the second part of his invention to consist in the separation of silver from lead by the use of zinc. He has since discovered, that when lead contains a very small proportion of silver, as compared with that mentioned in the former specification, the proportion of zinc required is different from that before stated, and should be varied according to the actual quantity of silver. In carrying out this invention, the lead is taken, in the state in which it comes from the smelting-furnace, and melted in an iron pot—a piece of green timber being introduced for the purpose of removing as much of the impurities as possible; and an addition is then made thereto of a quantity of melted zinc, dependent in amount upon the quantity of silver in the lead (which is previously ascertained by assay); and the whole is well stirred together for several minutes. The lead, before the zinc is added, should be heated to the temperature of melted zinc, and, after the admixture, permitted to cool down gradually, so as to allow the zinc and silver to rise to the surface; and when the lead is about to set, the alloy of zinc and silver is removed from the surface by means of a skimmer, or flat perforated ladle. With regard to the quantity of zinc requisite, the patentee has found that the proportion of 1 part of zinc to 100 parts of lead is sufficient when the lead contains 14 oz. of silver per ton; and in the same ratio for a greater or less quantity of silver: for example, to a ton of lead containing 14 oz. of silver, 22 lbs. 4 oz. of zinc should be added; to a ton of lead containing 21 oz. of silver, 33 lbs. 6 oz. of zinc; to a ton of lead containing 28 oz. of silver, 44 lbs. 8 oz. of zinc; and so on. He does not, however, confine himself to this precise proportion of zinc, as he has found that the requisite quantity depends greatly upon the purity of the lead—an increased quantity of zinc being necessary when the lead contains other metals or impurities besides silver.

* Described at page 436, *ante*.

Lead that has been treated with zinc, to extract silver therefrom, retains a quantity of the zinc, which renders it brittle; and the patentee therefore adopts the following process for removing the same:—The lead, whilst still melted, is run into a heated reverberatory furnace, and allowed to remain therein until it attains a dull red heat—at which point the zinc rises to the surface and becomes oxidized; the lead is then tapped into an iron pot and poled with green wood, to separate any oxide of lead that may be present; and, finally, it is ladled into the ordinary moulds. The oxide of zinc remains in the furnace, and is afterwards removed therefrom. The time required for the process depends upon the size of the furnace, and the quantity of lead operated upon: from two hours to two hours and a half is generally sufficient for quantities of 8 tons, extending, when melted, over a surface of from 25 to 80 square feet.

The alloy of silver, zinc, lead, and other metals or impurities obtained from the surface of the melted lead, is first concentrated by separating therefrom as much of the lead as possible: which is effected by putting it into an iron vessel, having a perforated bottom and a close-fitting cover, and heating the vessel till nearly red hot, when a large proportion of lead will escape through the perforations in the bottom. This lead, if the heat has not been raised too high during the process, will be found to contain only a minute quantity of silver, and may be purified or refined in the manner above described; but, if it should contain sufficient silver to make it worth repeating the process, it must be returned to the mixing pot for that purpose.

The concentrated alloy, from which the lead has been separated, may be treated in two ways: either it may be oxidized by subjection to a low heat, and then digested in sulphuric or muriatic acid, diluted with from four to six times its bulk of water; or it may be distilled in retorts properly constructed, so as to separate the zinc in the metallic form, leaving the silver and lead to be afterwards treated in the usual way.

When the alloy is treated according to the first method, it is placed in close retorts or muffles, and subjected to a low degree of heat; by continual stirring with an iron rake, the metals are partly oxidized and disintegrated, and at length fall down in a fine powder; the heat is then raised until the metals, with the exception of the silver, are completely converted into oxides; and the powder, so obtained, is put into cisterns containing dilute sulphuric or muriatic acid, whereby

the oxide of zinc is dissolved, and the silver falls to the bottom, and may be recovered by any of the known methods.

In the second mode, the concentrated alloy is distilled in retorts of a similar shape and size to those used for distilling zinc,—being made of the best Stourbridge clay, or other suitable material, and well tempered and dried: the patentee has also found that a wrought-iron tube, protected outside by a clay retort, and coated inside with a lining of pounded bones and charcoal, will answer the purpose. The retorts are placed in a furnace of the ordinary kind, and the distillation of the zinc carried on in the usual manner; and, after the separation of the zinc, the silver, lead, and other metals (if any) remaining on the bottom of the retort, may be tapped through a hole in the back of the retort, and subjected to the ordinary process of cupellation. It has been found desirable to mix a small quantity of charcoal or coke, in fine powder, with the alloys placed in the distilling retorts, for the purpose of reducing any oxides that may be present.

In conclusion, the patentee states, that he does not confine himself to the exact details of the several processes, as the same may be varied without departing from his invention.—[*Inrolled December, 1851.*]

To GAETAN KOSSOVITCH, of Middleton-square, in the county of Middlesex, Gent., for improvements in rotatory steam-engines,—being a communication.—[Sealed 3rd May, 1851.]

THIS invention relates to certain improvements in rotatory steam-engines; and the peculiar features of novelty are described as consisting in the constancy or regularity of the passage of the steam, and also the uniformity of the vacuum produced. This regularity is obtained by arranging the mechanism in such a manner that the introduction and escape of the steam takes place through certain moveable parts which rotate with the piston and its axle.

In Plate XIII., fig. 1, is a side elevation of the engine; fig. 2, is a longitudinal horizontal section of the cylinder and some of the principal working parts; fig. 3, is an end view of the cylinder and the parts immediately connected therewith; and fig. 4, is a longitudinal vertical section of the same. The body of the engine is composed of a hollow cylinder A, open at both sides to two semi-cylinders B, B¹, and, at its ends, to two cylinders C, C¹. The small end cylinder C, communicates, by the tube i, with the boiler; and the other

end cylinder c^1 , communicates, by the escape-tubes e , with the condenser or the atmosphere. All these parts are immoveable. The axle τ , passes through stuffing-boxes in the covers of the end cylinders c, c^1 . The middle of the engine is occupied by a hollow moveable cylinder D , with a piston x , shewn detached from the engine at fig. 5. This moveable cylinder is open at its ends, and communicates with the end cylinders c, c^1 ,—fitting so exactly to the sides of the great cylinder as to allow no loss of steam. It is connected with the axle by means of a strong plate ε , which cuts off the communication between the two cylinders c, c^1 , and, consequently, allows no direct communication between the tube i , which admits the steam to the cylinder, and the exit-tube e , which allows it to escape therefrom. The cylinder D , has two openings y, y^1 , one of which admits the steam into the great cylinder, and the other lets the steam out of the engine into the escape-tube. They are separated by the piston x ; and one of them is on one side and the other on the opposite side of the solid plate ε , which divides the inner space of the moveable cylinder into two parts.

The two semi-cylinders B, B^1 , contain two shutters or valves 1, and 2, each consisting of a semi-cylindrical column or body, and of two circular ends f, f^1 , which fit exactly into corresponding circular recesses in the lids or covers of the immoveable cylinder A , and of the semi-cylinders B , and B^1 ; and the shutters or valves turn, steam-tight, on centres a, a . The shutters or valves work alternately. In fig. 4, they are shewn in their different positions,—1, being open, to let the piston pass, and 2, being shut, and kept in contact with the moveable cylinder D . The space is full of steam, which enters by the opening y , and acts by pressing against the shutter or valve 2; and, by exerting its elastic force, it pushes forward the piston x . In the space marked with v , a partial vacuum is produced, by the escape of steam through the opening y^1 , which is not indicated in the figure—being behind the solid plate ε . The semi-cylindrical columns, which form the valves 1, 2, present to the piston a concave surface, forming exactly a part of the interior circumference of the great cylinder A , and are cut on the edges in the form of a concave circular surface, corresponding exactly to the outward surface of the moveable cylinder D ,—allowing no leakage, and producing but a slight degree of friction. The spindles or rods a, a , of the shutters or valves, carry, at one end, a simple concave pillar or curved cross-piece, marked z , and z^1 , which, when acted on by the excentric w , (see fig. 3,) on the axle τ , turns the shutter or

valve into the proper position to permit the piston to pass. The shutter or valve 1, or 2, being released from the pressure of the excentric, is turned back again on its centre by the action of a counterpoise, or by the pressure of steam, and keeps in contact with the moveable cylinder *D*. Or the motion of the shutters may be effected by means of an excentric *w*, (see fig. 1,) fixed on the axle *r*, which acts upon a lever *z*, on the axle of each of the shutters or valves,—the end of the lever being furnished with a roller to reduce the friction. The shutters or valves, on being released from the pressure of the excentric, are turned again on their centres by the action of counterpoises or springs, which connect the opposite ends of the levers *z*, *z*, and cause the valves to keep in contact with the moveable cylinder *D*.

Steam is conveyed from the boiler by the tube *i*, through the small end cylinder *c*, into one end of the moveable cylinder *D*; and, finding an immoveable obstacle in the plate *x*, it rushes through the opening *y*, into the great cylinder *A*, between the shutter or valve 2, and the piston *x*: by this means, it pushes forward the piston, and imparts to the axle a rotary motion. The shutter 1, being released from the pressure of the excentric, turns back (by the effect of a counterpoise, or of steam), and keeps in contact with the moveable cylinder *D*; and the steam continuing to enter by the opening *y*, finds itself enclosed between the shutter or valve 1, and the piston, and forces the latter onward. The shutter or valve 2, is, at the same time, turned by the pressure of the excentric *w*, to the requisite position for permitting the piston to pass; and the steam escapes through the opening *y*¹, in the other end of the moveable cylinder *D*, into the other small end cylinder *c*¹, and through the escape-tube *e*, which communicates with the condenser or atmosphere. Thus are obtained a constant and uniform pressure of steam on one side of the piston, and a constant vacuum on the other. The result is, a constant rotatory motion of the main shaft of the engine, without any variations, except the slight resistance of the turning shutters or valves.

The engine just described will act as well in a vertical as in a horizontal position; and a retrograde or backward motion can be easily obtained, by causing steam to enter by the exit-tube, and escape by the inlet-tube,—the position of the shutters being altered to correspond with the change. This engine is susceptible of considerable modifications in the construction or arrangement of some of the working parts, without changing or departing from the principle upon which it is con-

structed. For instance, if it should be found that the pressure of the steam against the circular plate *x*, in the moveable cylinder, has a tendency to alter the position of the axle *r*, and to push it endwise—the cover of the end cylinder *c*, and the cover of the other end cylinder *c*¹, could be made moveable, and screwed or otherwise secured to the axle *r*: by which means, equilibrium would be perfectly restored, as the axle *r*, could be prevented from moving.

Fig. 6, exhibits a modification which will be found advantageous when rapid changes of the direction of the engine are required, as in some marine engines: in this case, flat shutters, slides, or valves, are employed, instead of semi-cylindrical ones. The shutter or slide *h*, (represented in plan view by fig. 7,) moves to and fro between two metallic plates *g*, *g*¹, and is pushed out of the cylinder by two eccentrics,—one fixed on one side and the other on the opposite side of the cylinders: one of these eccentrics is shewn at fig. 8. The slide *h*, is driven back into the cylinder by a counterpoise-spring, or by steam-pressure. In this last case, steam can act by means of a cylinder, affixed to the boiler,—its circular piston being of a somewhat larger area than the area of the edge *a*, *b*, of the shutter, and a vacuum being obtained alternately with steam pressure. The slide *h*, moves easily between the two metallic plates, and is kept in an unvarying position by four rollers or guides *e*. Only one slide is shewn,—the other being of exactly the same construction. Rollers *r*, may be adapted to the slide in the places where it meets the eccentrics, to diminish the friction. Metallic packing *d*, is introduced in the surface of the great cylinder, for the purpose of preventing the escape of steam. The other parts of the engine are similar to those alluded to in the former description.

The advantage of this arrangement would be, the facility of producing the most rapid changes of direct and retrograde motion,—the loss of power being equal to the resistance opposed by friction, and to the resistance of steam against the edge *a*, *b*, of the slide *h*. The retrograde motion of the slide *h*, when pushed out of the great cylinder, will be easily effected, as it will be aided by the effect of the vacuum produced in the little steam apparatus affixed to the boiler, and which, when filled with steam, pushes the slide into the great cylinder *A*. The openings for the introduction and escape of steam may be made in the body of the piston itself, which may be of an oval form, for the purpose of obtaining greater solidity.

Fig. 9, is a horizontal and fig. 10, a vertical section of an-

other modification of the engine, in which, instead of the slide *b*, two pairs of sliding-plates *a*, and *a'*, are used. These plates work through openings in the ends of the large fixed cylinder, and act against the surface of the moveable cylinder and the inner surface of the fixed one,—meeting, steam-tight, in the middle. The sliding-plates may be moved backwards and forwards by the pressure of springs, condensed air, or steam. All the other parts of the engine are similar to those described in the former plans; but, in this case, the diameter of the moving cylinder may be considerably reduced.—[*Inrolled October, 1851.*]

To **LEMAN BAKER PITCHER**, of *Syracuse, in the State of New York, and United States of America, Gent.*, for improvements in apparatus for regulating motive-power engines.—[Sealed 2nd October, 1851.]

THIS invention consists, firstly, in an improved arrangement and construction of apparatus for regulating the supply of steam or other elastic vapour to motive-power engines; and, secondly, in the mode of mounting or adjusting disc valves, when applied to such engines.

In Plate XIII., fig 1, represents, in sectional elevation, the improved regulator, in connection with the valve of a steam supply-pipe; fig. 2, is a sectional elevation of the regulator, taken at right angles to fig. 1, and shewing the steam supply-pipe and its valvular arrangement in vertical section; and fig. 3, is a similar plan view, taken in the line 1, 2, of fig. 1.

The principle on which this apparatus works is by causing a rod (which is in connection with the valve of the steam supply-pipe) to ascend and descend with sudden jerks, and thereby either to act upon the valve at every impulse (the amount of its action increasing or decreasing according as the speed of the engine is either unduly increased or diminished), or to act only when the speed of the engine is required to be changed. This up-and-down motion of the rod, in connection with the valve, is obtained by forcing water or other fluid (by means of a reciprocating supply-pump) against the under surface of a plunger or piston, attached to the rod, and by providing means for the escape of this fluid from beneath the plunger or piston,—whereby the rod is enabled to descend by its own gravity. *a*, is a cast-iron case, secured by bolts to a bottom plate *b*, and covered at top by a plate *c*, which is also connected to the case by bolts. Attached to the plate *b*, is a

valve-chest, having two compartments *d*, *e*, which communicate with each other by a third compartment *f*. The compartments *d*, and *e*, are provided with horizontal partitions, having circular openings, which form seats for disc-valves *g*, and *h*, respectively. The top of the valve-chest is also provided with circular openings immediately above the valve-seats; and over these openings in the top of the valve-chest, cylinders *i*, and *k*, are respectively fixed by screw bolts. In these cylinders, the pistons *i**, *k**, respectively work: the former is fitted in the ordinary manner of pistons; but the piston *k**, works loose in its cylinder, to prevent friction of contact therewith; and the rods *l*, *m*, of these pistons pass upwards through the cover *c*, and through cups attached thereto for returning the water that may be carried up by the rods. The piston-rod *l*, is connected to an excentric, or a crank, on the shafting in connection with the steam-engine required to be regulated; and the rod *m*, is connected with the valve of the steam supply-pipe. The valves *g*, and *h*, work on central guide-rods, which are bolted to the bottom plate *b*; and they have each a tendency to retain their seats, by reason of a coiled spring interposed between, and confined by, the head of the central rod and the valve itself. The cylinders *i*, and *k*, are both open at top. The cylinder *i*, with its piston, forms a force-pump for drawing water or other liquid from the case *a*, and forcing it into the cylinder *k*. This cylinder *k*, is furnished with a lateral exit-pipe *n*, the capacity of which is determined by an adjustable plug, for the purpose hereafter explained. This plug consists of a rod *o*, which is threaded at each end, and projects through the cover of the case *a*. At its upper end there is a nut, to keep it in place; and its lower end projects into the lateral pipe *n*, through a tapped hole made to receive it. When, therefore, the rod *o*, is turned, by means of a key applied to its upper or squared end, it is raised or depressed as required,—and thereby the capacity of the exit-pipe is enlarged or diminished. In lieu of this exit-pipe (which is intended to permit of an escape of the fluid pumped into the cylinder *k*), or in combination with it, an opening, made for the same purpose through the piston *k**, may be used; or the space between the piston *k**, and the cylinder, may be sufficient to admit of the same effect being obtained. By increasing or decreasing the capacity of the vents for allowing the escape of fluid from under the piston *k**, and so accelerating or retarding its descent, the traverse of that piston in its cylinder will take place at a higher or lower position in the said cylinder, and thereby bring the

regulator valve into action, so as to adjust the speed of the engine. The rod which connects the piston-rod *m*, with the valve of the steam supply-pipe, is passed through an eye *q*, carried by an arm *r*, on the valve spindle, and works freely therein. On this rod are two nuts *s, s*, which are capable of being adjusted to any given position. These nuts act as tappets, and cause the movements of the piston *k**, (when the action of the supply-pump is too feeble or too strong) to take effect upon the valve; whereby a greater or less amount of steam will be allowed to pass through the supply-pipe to the engine, and thus bring the engine to work at the speed required.

The action of the apparatus, and the means of regulating the amount of steam to be supplied to the engine, are as follow:—The case *a*, is filled with water or other fluid; and the engine having been set in motion, the piston *i**, of the cylinder *i*, will cause a flow of water from the case *a*, into the compartment *d*, of the valve-chest, through the opening 1, (see fig. 8). As the piston ascends, the valve *g*, will rise from its seat, and allow the water to flow into the compartment *f*; and, by the descent of the piston, the water is driven out of the compartment *f*, through the opening 2, into the compartment *e*,—whence, by lifting the valve *h*, it flows into the cylinder *k*, and causes the piston *k**, to rise with a jerk. The descent of the piston is effected by gravitation (a weight being attached to the piston-rod, if required, to expedite the movement); and it is controlled by the discharge of the fluid in the cylinder *k*, below the piston. Around the piston-rod *m*, is a coiled spring *t*, for preventing the rod from rising beyond the position for closing the regulating valve: without this precaution the cut-off valve might be driven past the cut-off position,—thereby letting in steam when it was least wanted. When the piston, by reason of the increasing speed of the engine, has a tendency to rise too high, the spring comes into contact with the top *c*, of the case *a*; and, by presenting an elastic resistance to the further upward movement of the piston, it will cause a more rapid escape of fluid from under the piston. A similar effect may be obtained by making lateral holes in the cylinder *k*, as at *p, p*; which holes, when the piston is driven past them, will form supplemental exit-passages for the water that has been forced into the cylinder, and thus relieve the piston of the accumulation of water consequent upon the increase in the speed of the engine.

It will now be understood, that at every ascent and descent of the piston *i**, the rod *m*, will rise and fall; and that,

according to the adjustment of the tappets *s, s*, and the speed at which these pulsations follow each other, will be the effect produced on the valve: *i. e.*, if, from the engine working at an increasing speed, the supply of water to the cylinder *k*, be greater than the discharge, the water will accumulate under the piston, and cause its reciprocating action to take place in a higher part of the cylinder than before. The consequence of this will be, that the nuts, or adjustable tappets, will raise the valve-lever *r*, and thus change the position of the valve; and a reduced quantity of steam will therefore be supplied to the engine, until the amount of water thrown into the cylinder *k*, is brought down to equal the capacity of the vents for discharging the same. If, on the contrary, the speed of the engine is suddenly slackened, by reason of a greater quantity of work being put upon it, the piston *k**, will sink, and perform its reciprocating action in a lower part of the cylinder; and the tappets *s, s*, following this change of position, will, by depressing the lever *r*, open the steam-ways in the valve to a greater extent, and thereby afford a greater supply of steam to the engine.

To prevent the piston or plunger *k**, from beating against the parts situate beneath it, when the engine is below speed, and so injuring the apparatus, a coiled spring *u*, is provided, which will come in contact with a lip on the head of the piston-rod, and thereby afford an elastic resistance to the further downward movement of the piston.

The construction of valve which the patentee prefers to use in connection with his improved regulating apparatus, is that known as the disc-valve, and shewn in front view at fig. 4; but other constructions may be used, if thought desirable. He also prefers (although it is not absolutely necessary) that the distance between the stops or nuts *s, s*, shall be so determined, with respect to the length of traverse of the rod which carries them, that, at every up-and-down motion of the piston *k**, the valve shall be caused to move slightly on its seat: by this means, the liability of the valve to stick will be avoided; and it will be in constant readiness to answer to the motions of the regulating apparatus.

The improved mode of mounting disc-valves is shewn in cross section at fig. 2. The valve *v*, is ground to a flat seat *w*; and both the valve and seat are pierced with corresponding concentric holes, set at equal distances apart. *x*, is the spindle, which carries the valve, and to which the arm *r*, fig. 1, for moving the valve, is affixed. This spindle works in suitable bearings in the steam-pipe; and it is prevented from moving

endwise (when not required to do so) by means of an adjustable nut *y*, which is made to abut against the removable cap of the steam-pipe. The inner end of the spindle *x*, bears against the end of a screw *z*, inserted in the steam-pipe; and, by means of this screw and the nut *y*, the proximity of the valve to its seat may be adjusted to the greatest nicety: thus the grinding of the two faces together, and the loss of power, as well as the rapid destruction of the two parts, consequent thereon, will be avoided.

The patentee claims the general arrangement of apparatus, as above described, for regulating motive-power engines; and, particularly, he claims, First,—applying the motion communicated to a plunger by a force-pump to actuate the cut-off valves of steam and other motive-power engines. Secondly,—actuating the valve, which governs the supply of steam or other motive-power agent to the engine to be regulated, by means of adjustable tappets, having a reciprocating motion, as above described. And Lastly,—the mode of mounting or adjusting disc-valves, in the manner and for the purpose above set forth.—[*Inrolled April, 1852.*]

To JOSEPH ROBINSON, of the Ebbw Vale Iron Company, CHARLES MAY, of Great George-street, Westminster, civil engineer, and WILLIAM THOMAS DOYNE, of Euston-square Station, civil engineer, for improvements in the permanent way of railways.—[Sealed 4th November, 1851.]

THIS invention is stated by the patentees to consist in “improvements in obtaining continuous bearing to the under surfaces of the rails on plates of wrought-iron, fixed on either side of the rails.”

In Plate XIV., figs. 1, 2, 3, 4, 5, 6, and 7, exhibit several sections of rails, supported by plates of angle iron, formed suitably for being fastened on either side of a rail, so as to offer a continuous bearing to the under parts of the rail; and these side bearing-plates, in laying down a line of railway, are to be placed on either side of the rail, in such manner as to break joint with each other. The forms of the side or bearing-plates may be varied; as will be seen on referring to figs. 1, to 7, where different forms of plates are used in each case; and the forms may be still further varied, so long as the peculiar character common to the whole is retained: which peculiarity consists in the plates

offering a longitudinal support to the under part of the rail, as is indicated by the letters *a, a*. The modes of fixing the plates to the rails, and to each other, may likewise be varied. In figs. 1, 2, 3, 4, and 5, the bearing parts *a*, are similar, and come at the very bottom of the rails; whilst the rails are enclosed above by the plates on either side. In fig. 6, the rail is notched at *a*, so that the bearing parts may come under such parts *a*, and afford support to the rail longitudinally. In fig. 7, a trough-rail is used; and the upper parts of the plates are suitably formed to fit within the rail, which rests upon the bearing parts at *a, a*.

The patentees claim, as their invention, the mode of constructing the permanent ways of railways by combining with the rails bearings in the form of wrought-iron plates, offering longitudinal supports *a, a*, as shewn and described. —[Inrolled May, 1852.]

To SIR JOHN SCOTT LILLIE, *Knight, Companion of the Order of the Bath, of Pall Mall, in the county of Middlesex, for improvements in forming or covering roads, floors, doors, and other surfaces.*—[Sealed 9th October, 1851.]

THE improvements in roads, streets, and foot-ways, described in this specification, consist in combining metallic substances with coarse gravel, small pieces of stone, wood, or bricks, by means of concrete, bituminous compounds, or other cements. For instance, the patentee causes numerous separate metallic bolts, of a wedge-like or any other convenient shape, to be imbedded perpendicularly in the compound material; or they may be previously fixed in wooden or metallic frames, so as to present an appearance somewhat similar to a harrow reversed,—the spaces between the tines or metallic points being filled with any of the above-named materials, combined with cement. Blocks or slabs, of any convenient size or shape, may be thus cast in moulds (with grooves in them to prevent horses from slipping), and laid on the surface of streets or roads already formed, or upon any solid foundation, as flags are usually placed on foot-ways. The dimensions of these metallic substances must depend upon the nature of the traffic they are required to sustain, and the solidity of the foundation: if bolts, for instance, one inch in diameter, or plates, two inches wide by half an inch thick, in rows two inches apart

and six inches deep, are required for the surface of carriage-roads,—one-third of these dimensions will be sufficient for foot-ways. The metallic pieces may be hollow in the centre, and placed separately in the cement, without a frame, or connected together like a series of rings, or at acute angles; or they may be placed, with or without cement, between rows of wooden blocks, in a transverse direction to the line of traffic.

For the surfaces of doors or partition-walls, the patentee causes two metallic plates, of the required height, to be bolted together, with a space between them proportioned to the thickness required; and this space is then filled with the before-mentioned combination of materials. For walls in which a greater degree of strength is required, this combination of materials is cast into solid or hollow blocks in a mould;—one of the faces of each block being composed of a metallic plate or stone (natural or artificial), attached by the cement in the mould; and such faces forming the surface at each side of the wall.

For the surfaces of railways, the patentee states, that he lays down metallic plates at each side of the rail, fastened together with transverse bolts; and he then fills the intervening space with the combination of materials, studded with perpendicular bolts or plates, as before described for ordinary roads.

To prevent the noise and other evils occasioned by the concussion of the solid metallic surfaces of carriage-wheels and horse-shoes on stone pavements, he covers such solid metallic surfaces of carriage-wheels and horse-shoes with gutta-percha, asphalted felt, vulcanized India-rubber, or other suitable material, studded with metallic bolts, nails, or screws, which will serve, at the same time, to attach such material to the tires of the wheels and the horses' shoes or hoofs.

The patentee claims the combination of materials for the construction or covering of roads, floors, doors, and other surfaces, as above described.—[*Enrolled April, 1852.*]

To GEORGE PHILLIPS, of Upper Park-street, Islington, in the county of Middlesex, chemist, for an invention for preventing the injurious effects arising from the smoking of tobacco.—[Sealed 18th September, 1851.]

It is well known to chemists that tobacco contains two highly

poisonous constituents, nicotine and nicotianine, and that these substances volatilize at different temperatures,—the former at about 320°, the latter at about 212° Fahr. In ordinary smoking, these substances (known as oils of tobacco) distil over with other products, and pass into the mouth of the smoker,—a portion of them being retained and absorbed by the system, to the detriment of the health of the smoker. Now the object of this invention is the separation of these deleterious substances from the smoke, which the patentee effects by first lowering the temperature of the smoke below the volatilizing points of nicotine and nicotianine, and then separating them from the smoke by filtration. The condensation may be effected in a variety of ways: thus, he has accomplished it by means of small tubes and sheets of metal, arranged so as to form worms; these he surrounded with substances that favor condensation, such as water, damp flannel, sawdust, or other matters that will abstract the heat from the smoke; he has also arranged the tubes or pipes so that a current of air may pass over the exterior of the tubes that form the worms. These contrivances have answered the purpose tolerably well, but have been found objectionable on account of their bulk and weight; and another mode of effecting the object is therefore preferred, viz., to pass the smoke over an extended surface of some suitable substance or material, so as to cool it to the desired point, and then filter from it the matter thus condensed. The material preferred is unwashed wool, commonly known as "wool in grease;" but various other fibrous substances or materials may be employed as well. Thus, sawdust, raspings or chips of wood, cork, broken leaves of trees, hay, bark, grass, paper, charcoal, thin sheets of metal, wire-gauze, fragments of metal, pieces of pumice and other light stone, asbestos, all kinds of textile fabrics (such as woollen, cotton, linen, and silk) cotton-wool, raw silk, hair, feathers, sponge, sand, or other pulverized material—cool down the smoke, condense the oils, and act as filters, to separate the before-mentioned deleterious matters from the smoke. The great desideratum, so far as condensing power only is concerned, is extent of surface of the material or substance employed, and its conduction of heat; and the next point is filtration: for which purpose, proper closeness of the material or substance used is required. These being attended to, any suitable substance will effect the object. Beyond the mere attainment of condensation and filtration by surface and closeness of material, the patentee has found that all fixed oils and fats may be used with advantage with the

material employed. This arises from the circumstance that fixed oils and fats unite with the oils of tobacco distilled over during the operation of smoking, and retain them, but permit the empyreuma or true smoke to pass. Thus it has been found that, in drawing tobacco-smoke through a cistern or reservoir of oil or soft fatty matter, or over or through any fabric or substance covered with them, the oils of the tobacco are retained, while the smoke is allowed to pass: hence the advantage of the wool in grease as a condensing and filtering medium. The oils of tobacco may also be separated from the smoke by means of any alkaline substance or solution, either by passing the smoke over fragments of such substances, or through diaphragms wetted with alkaline matter; but the flavor of the smoke is injured in a greater or less degree, according as the substance with which it comes in contact is more or less alkaline.

The manner of applying the material which is preferred to be used is as follows:—The wool is carded and placed moderately tight in a glass tube, or any other suitable vessel, and secured in any convenient manner, so as to prevent it from shifting: for which purpose, perforated corks are preferred to be fitted inside the tube, close to the wool. The corks are placed at convenient distances from the ends of the tube, which receive the pipe and fittings hereinafter described. As a certain quantity or continuous length of the filtering material is necessary to secure a perfect action, a length of not less than 3 inches should be applied in a tube, the diameter of which is $\frac{3}{4}$ ths of an inch and upwards. If the tube be less than $\frac{3}{4}$ ths of an inch in diameter, the quantity of the wool or filtering medium must be increased, according to the smallness of the tube. Diaphragms of flannel, cotton, linen, silk, hair, wire, or any other textile fabric, arranged singly, or in a series, may be applied, and, if properly constructed, answer pretty well, as a condensing and filtering arrangement; but they are not so convenient for cleansing as the above material.

To prevent the condensed oils, water, &c., from running into the pipe-bowl, a reservoir is formed for their reception inside of the tubes, in the manner shewn in Plate XIV.; in which fig. 1, represents a longitudinal section of a pipe, of the simplest and cheapest form, constructed according to these improvements. The bowl of the pipe *a*, is constructed (for the sake of economy) of clay, having a stalk *b*, on which a cork *c*, is fitted against the shoulder *d*. The glass tube *g*, forms the body of the pipe; and, in the lower end of this tube, the pipe-stalk *b*, is inserted and fixed tight by the cork *c*.

The mouth-piece *f*, is attached in a similar manner to the top of the tube *g*, by a cork, that is fixed on the perforated peg or tube *h*,—such peg or tube protruding beyond the cork; and, when the mouth-piece fitting is attached to the tube *g*, a reservoir or chamber is thereby formed, which, when the pipe is laid down, prevents any condensed matter from reaching the mouth-piece. When the parts of the pipe are connected together, the stalk of the pipe-bowl stands up inside the tube *g*, and forms a reservoir for the oils and condensed matter to collect in; and which, by detaching the pipe and fittings, may be emptied at pleasure. In the tube *g*, is also placed the filter *k*, for taking up and retaining the oils of tobacco as the smoke is drawn through it; and perforated corks *l, l*, are placed within the tube, to keep the filter in its place. The stalk *b*, or projecting part of the pipe, may be bent, or made, as shewn at fig. 2, with a cap *i*, to cover the orifice *e*, through which the smoke issues into the tube *g*. This cap may be formed either of clay, metal, wood, or any suitable substance, and is intended to prevent the condensed oils, &c., from dropping into the orifice *e*, through which the smoke issues. A small vessel or cup *j*, of any suitable material, may also be fixed on the stalk *b*, of the pipe, as shewn at fig. 2, and fitted to the tube; so that, when the pipe is detached, the condensed oil, water, &c., collected in the vessel or cup, may be brought out with the pipe and emptied.

The tubes or pipes for meerschaum bowls are similar in arrangement and construction, as regards the reservoirs and other parts, to what has been described for the common pipe; and they may be either fitted to the meerschaum bowl in the ordinary manner by means of a cork, or by means of screw-joints, or in any other convenient way. At fig. 2, is shewn one of the improved pipe-tubes, intended to be applied to meerschaum bowls. The fittings may be attached to the tube without a cork, either by telescopic or screw-joints: thus a plain ferrule or ring-screw may be cemented to the glass or other tube, to which the fittings, having a cup or hollow vessel, of any suitable shape, are shut on or screwed. The hollow vessel forms the reservoir, and may be arranged so as to have the reservoir either outside or inside the end of the tube.

In the upper part of the tube that contains the filter, and next the mouth-piece, both in the tube used with the common pipes, and also in the meerschaum tubes, a space is left for the insertion of a sponge, which may be wetted with water when a mild or water-pipe is required.

For cigar smoking, the patentee arranges tubes similarly

prepared to those used with meerschaums, with the exception that the end of the tube, or fitting next the pipe, instead of having a cork, has a cavity for the reception of the cigar.

The patentee claims, First,—the use of any suitable material or substance applied to the various modes of cooling down the smoke, condensing the oils, and filtering them from the smoke, as above described; also the use of fixed oils and fats for the purpose herein described. Second,—the construction and arrangement of the several parts of a pipe, as shewn; and also the mode of adapting the bowl of the pipe to the tube, as shewn in fig. 1, so as to form a reservoir for the reception of the condensed oils, &c.; likewise the mode of forming the reservoir at the bottom and top of the tubes for meerschaums, as described and shewn; and also the mode of applying a wet sponge at the top of the tube, to form a water-pipe. He further states that, in applying the materials and substances for condensation and filtration, he does not confine himself to the use of glass tubes only, as any suitable substance, made in a convenient form, may be used for the purpose herein described.—[Enrolled March, 1852.]

To WILLIAM EDWARDS STAITE, of Throgmorton-street, in the City of London, Gent., for improvements in pipes for smoking, and in the apparatus connected therewith.—
[Sealed 4th March, 1850.]

THE improvements in pipes for smoking, and in apparatus connected therewith, which constitute this invention, consist, firstly, in so constructing the bowls and stems or tubes of pipes as to prevent (so far as is practicable) the oil produced by the combustion of tobacco from passing up the stem or tube, and thence into the mouth and stomach of the smoker; secondly, in certain additions to the stems or tubes of pipes; and, thirdly, in an improved tobacco-stopper.

Fig. 1, in Plate XIV., exhibits what the patentee terms "the patent diaphragm pipe," in vertical section. The hollow or cavity *a*, of the bowl communicates by a tubular passage *b*, with a cup or receiver *c*, that fits on to the bottom of the pipe. On the outside of the tube *b*, there is fitted or formed a perforated diaphragm *d*, extending across the chamber that surrounds the tube *b*, and which communicates at the top with the socket *e*, for the stem of the pipe. This socket is in all cases above the diaphragm; so that the smoke must descend through the passage *b*, into the cup *c*,

and then impinge against and pass through the perforated diaphragm, before it can enter the stem. The oil and vapour being intercepted, fall into the cup *c*, which must be taken off and emptied before the ash is thrown from the bowl, in order to prevent the oil running back into the bowl, or finding its way into the stem.

Fig. 2, is a sectional representation of another pipe, also named "the patent diaphragm pipe." The cavity *a*, of the bowl communicates by a hole *b*, with a chamber beneath, containing a partition *f*, with a perforated diaphragm *d*, at the lower part of the same. The bottom of the partition is pointed at the centre, to facilitate the dropping of the oil and condensed vapour into the cup *c*; and the partition may be inclined at any angle, or placed perpendicularly down the centre of the chamber, as represented at fig. 3. When the pipe is in use, the smoke descends through the hole *b*, into the chamber, and thence into the cup *c*, where it impinges against and passes through the perforated diaphragm in its course to the stem.

Fig. 8, is a vertical section of a modification of the pipe shewn at fig. 2,—the principal point of difference being, that the partition *f*, is, in this instance, vertical.

The patentee states, that either of the foregoing pipes may be constructed with one or more diaphragms, and that these diaphragms may be inserted in pieces (not perforated), step fashion, one above another, as represented in the vertical section, fig. 4. Likewise, for the better collection of the oil and vapour, a diaphragm, perforated as above described, may be inserted in any suitable part of the socket that receives the stem.

Fig. 5, is a sectional representation of part of an improved stem, to be employed with pipes made according to this invention, or with pipes of any other construction which are used with moveable stems. *g*, is part of the stem connected with the bowl of the pipe; and *h*, is the portion that leads to the mouth-piece. These two portions are united by a small apparatus for collecting the condensed vapour, consisting of an inclined tubular body *i*, having a short descending portion *j*, which is divided vertically by a central division or partition, carrying a perforated diaphragm at the bottom. Upon the lower end of the part *j*, is fitted a cup *c*¹, for receiving any oil or condensed vapour that may not have been collected by the cup or receiver appended to the bowl of the pipe; or, in cases where the bowl is not constructed according to this invention, the

cup *c*¹, collects the oil and condensed vapour direct from the bowl.

Fig. 6, exhibits, in section, another addition to pipe-stems, intended to be used either separately or in conjunction with the foregoing. *g*, and *h*, as in fig. 5, indicate parts of the stem, communicating with the interior of a hollow sphere *k*, which is divided into two parts by a partition. In this partition there are two openings *l*, *m*. The opening *l*, is fitted with a valve *n*, which opens towards the part *h*, of the stem (leading to the mouth-piece), to permit the smoke to pass, but closes upon the partition, when the smoke is being expelled from the mouth, "and prevents waste of tobacco by the back puff." The other opening *m*, is closed by a slide *o*, which is pressed against the partition by a spring *p*; and the stem or rod of the slide is fitted with a helical spring, which keeps the slide in the proper position to close the opening, except when the slide is pushed past the opening (by pressing on the top of the rod), in order that air may be blown through the stem, to clear it.

Fig. 7, shews the improved tobacco-stopper, intended to be used with all descriptions of pipes. It may be made to fit on the top of the bowl with sufficient adhesion to retain it in its place; or it may be permanently connected thereto by a hinge-joint, in such manner as to admit of being turned over when it is desired to empty or replenish the pipe. *q*, is the stopper, attached to a rod *r*, which passes through an opening in the centre of the bridge-piece *s*, hinged to the bowl *a*; and the rod *r*, is fitted with a helical or other suitable spring, to keep the stopper away from the bowl when out of use. The stopper is caused to enter the bowl by pressing on the top of the rod, and is raised therefrom by the spring, on the pressure being removed.

The patentee states, that what he claims, as his improvements in pipes for smoking, and in apparatus connected therewith, is, First,—the combination of parts, both as regards pipes and stems, having a diaphragm or diaphragms, whereby the oil and condensed vapour are intercepted and collected in a receiver, and are thus prevented from entering the mouth of the smoker, as hereinbefore described. Second,—the valve-stem and slide-piece, as described and represented at fig. 6, whereby waste of tobacco and smoke by the back puff is prevented. Third,—the improved tobacco-stopper hereinbefore described.—[*Inrolled September, 1850.*]

To WILLIAM EDWARD NEWTON, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in casting type,—being a communication.—[Sealed 23rd April, 1850.]

THE improvements in machinery for casting type, which constitute this invention, consist principally in arranging the mould-block on a horizontal slide-rest, worked or vibrated by a cam on the main shaft, and also furnished with helical springs, to draw it back; in combination with which horizontal slide, there are levers, for opening the mould-block and holding the matrix up to it, and in its place, when the mould-block is being charged with the type-metal; and on the main shaft there are also mounted two other cams,—one of which works the piston or plunger in the well of the machine, for the purpose of ejecting the fused metal into the mould-block; and the other cam acts on a set of levers, for working a stopper within the nipple or nozzle of the fused metal-bath, so as to cut off and regulate the flow of the fused type-metal while the mould-block is being drawn back to discharge the type.

In Plate XIV., fig. 1, is a side elevation of the machine; fig. 2, is a plan view thereof; fig. 3, is a detached view of the horizontal slide and levers in combination therewith; fig. 4, is a cross section through the mould-block; fig. 5, a side view of the matrix-spring, matrix, and matrix-holder, detached; fig. 6, is a cross section of the fused metal-bath, well, plunger, nipple-stopper, nipple-stopper chamber, and other parts connected therewith; and fig. 7, exhibits the nipple-stopper detached. *a*, is the bed or foundation-plate of the machine; and *b*, the main shaft, supported by two standards or bearings, affixed to the bed-plate. *c*, is a cam on the main shaft, for actuating the horizontal slide *d*, by means of a roller *e*, mounted in bearings *e*², on its under side. The horizontal slide is made of a peculiar shape, so as not to interfere with the cam *c*, immediately underneath it on the main shaft; and, by the fork-shaped end, room is allowed for working the levers which open the mould-block. On the front end of the slide *d*, is a stem or rod *f*, supported in bearings *g*, whereby it is held in a horizontal position, when vibrating backwards and forwards on the guide-ways or rests *h*, *h*. The horizontal slide is canted on one side, or mounted obliquely in the guides, so as to be inclined at an angle of about 45°, in order that the mould-block shall, when opening, on returning from the nipple, allow the type to fall freely by its own gravity from the block. *i*, is the mould-block, attached by screw-bolts to the

end of the horizontal slide d ; and i^3 , is the upper half of the mould-block, working on a hinge i^3 , which is secured to the back of the lower half of the mould-block by two screws. j , is a lever, the upper end whereof is bent at right angles, so as to fit into a loop on the upper side of the mould-block, for the purpose of opening and shutting the same, as the horizontal slide is moved backwards and forwards. The slide d , when vibrating backwards and forwards, actuates two levers k , and l , which are connected to the lower end of the lever j . The first of these levers k , is attached, at one end, at right angles to the lower end of j , and, at the other end, to an adjustable bracket k^2 , on the shoulder (or junction of the bow and shoulder) of the slide d , so as to allow length enough of the lever to give free action to the downward pull of the lever l ; which lever l , is attached to the back end, or nearly so, of the lever k , and, at its opposite end, to the stationary bearings or standards of the main shaft; so that, as the horizontal slide is moved backwards or forwards, it draws on the end of k , which, being connected to the lower end of j , (as before stated), opens or shuts the mould-block at the required time.

m , is the matrix-spring, attached to the upper side of the horizontal slide, and having its point inserted into a small indentation at the upper and back side of the matrix n , for the purpose of holding it up to the mould-block when being charged with metal. Against the under side of the point of the spring the head of a small lever m^2 , is made to press, in order to hold the matrix in firm contact with the mould-block when the horizontal slide is projected up to the nipple. This lever m^2 , is about six inches long, and is mounted, near its middle, on a pin or stud, attached to the inside of the horizontal slide, so as to allow of its working when its lower end comes in contact with an adjusting stop-plate m^3 , on the back of one of the guides h . In the lower end of the lever m^3 , is an adjusting stop-screw m^4 , for regulating the pressure under the end of the matrix-spring, when it is forced against the stop-plate by the pushing up of the horizontal slide and mould-block. o , is a right-angled lever, having an adjusting screw in its upper end, to bear against the lower end of the matrix n , and sustain it in its proper place against the mould-block. The lever o , is mounted on a pin or stud, attached to a shoulder-piece o^2 , on the lower side of the under half of the mould-block; and this stud or pin serves as a centre of action, as the roller on the horizontal leg of the lever o , is raised or depressed by running over the blocks o^3 , during the backward and forward motion of the horizontal slide and

mould-block. These blocks o^3 , are attached to the cross-bar of the stand h , and are so constructed as to admit of adjustment, for the purpose of regulating the length of time that the horizontal leg of the lever o , is kept raised or depressed, and, consequently, the time that the lower end of the matrix is kept in contact with the mould-block.

p^1 , and p^2 , are two helical re-acting springs, attached, at one end, to stationary parts of the machine, and, at the opposite end, to the horizontal slide, for the purpose of drawing it from the nipple when the mould-block has been charged, and also for keeping the under side of the roller e , always in close contact with the cam c , on the driving-shaft. A cam r , for actuating the plunger or piston, is secured on the main shaft, having an excentric variation of about three-fourths of an inch, more or less, as may be required, for the purpose of elevating or depressing the horizontal lever r^2 . This lever works on a pin attached to the standard r^3 . One end of the lever carries a friction-roller; and the other end is secured to a helical spring r^4 , fastened to the bed-plate, and is also connected by a rod r^5 , to the outer end of the piston or plunger-lever r^6 . This piston-lever turns on a centre-pin, attached to the side of the frame that supports the piston-rod; and, at its inner end, is keyed to the piston-rod s , on the lower end of which is a plunger s^2 , (see fig. 6). The piston or plunger works in the molten metal-well t , which is formed in the bottom of the metal-bath. t^2 , is a channel or passageway, communicating from the lower part of the well to the nipple-chamber u , for the admission of the fused metal from the bath from behind the stopper, when forced into the aperture of the nipple by the descent of the plunger, which ejects it into the matrix when the stopper w , has been withdrawn. v , is a cam, for actuating the nipple-stopper: it is about two inches in diameter, except for about one-third of its circumference, which is abruptly reduced half an inch, more or less, so as to give sufficient motion, as it rotates, to actuate the back end of the V-shaped bent lever v^2 . This lever turns on a centre-pin v^3 , attached to the bed-plate a , so as to work the outer end of the horizontal stopper-lever v^4 , (see fig. 2,) connected with it by a pin. The lever v^4 , is, at about midway of its length, mounted on a stud or centre-pin, fixed on the top of the metal-bath; and, at its inner end, it is connected to the stem of the nipple-stopper w : therefore, as the lever v^2 , is actuated by the cam v , it will move the nipple-stopper out and in, so as to allow the well to be charged with the fused metal, and the metal to be discharged again there-

from into the matrix. The nipple-stopper *w*, is placed within the interior of the nipple *u*², which is formed by boring, in the side of the bath, a chamber *u*, of a suitable form and size to accommodate the nipple-stopper; and a breech-piece is inserted in the back of the nipple-chamber, so as to enclose the stopper, merely leaving a passage-way for the stem of the stopper to communicate with the end of the lever *v*⁴. This chamber *u*, is made a little larger than the stopper, for the purpose of allowing room for the flow of the fused metal by or past it, when the stopper is drawn back and the metal is being discharged into the mould-block; and also, when it is forced forward into the aperture of the nipple, to allow the metal to flow from the bath through the orifice in the breech-piece to the under side of the plunger through the channel-way *t*². Underneath the roller-end of the lever *v*², is a helical re-acting spring *v*⁶, which holds the end of the lever firmly in contact with the cam, and draws it back, so as to withdraw the stopper from the aperture of the nipple, while the mould-block is being charged with the fused metal. The bath *x*, is set on the upper edges of a furnace *y*, having a mouth or feed-box *y*², in its side, for supplying it with fuel; and at the back there is a smoke-pipe *y*³, for the escape of the gas.

The operation of these various parts is as follows:—When the machine is set in motion by means of the driving-wheel *z*, the cam *c*, acting on the roller *e*, causes the horizontal slide *d*, to move up towards the bath. In doing this, the lever *l*, is caused to draw the lever *k*, down, and with it the vertical lever *j*, so as to shut the mould-block; and, while this is being done, the same backward motion of the horizontal slide brings the adjusting screw *m*⁴, in the lower end of the lever *m*², in contact with the stop-plate *m*³, which throws the upper end of the lever forward, and lifts and sustains the point of the matrix-spring *m*, firmly in contact with the matrix *n*; it also causes the horizontal end of the lever *o*, to rise on the second or upper block *o*³, and thereby throw the vertical leg back against the lower end of the matrix; so that, by the joint action of the levers *m*², and *o*, the matrix is kept firmly up to its place against the mould-block, while being charged with the fused metal. At the same time that the mould-block is being presented to the nipple, the plunger-cam *r*, elevates the plunger *s*², and the cam *v*, forces the stopper into the vent of the nipple,—allowing thereby the flow of the fused metal, by the stopper-stem, through the orifice in the breech-piece to the interior of the nipple-chamber *u*, and thence, by the channel-way *t*², to the under side of the plunger in the

well. By the time this has been accomplished, the mould-block has been presented to the nipple, and the nipple-stopper-cam *v*, allows the re-acting spring *v*⁵, to draw back the stopper in the chamber *u*, so as to close the entire orifice for the stem in the breech-piece; while, simultaneously with the motion of the stopper, the plunger is forced down, and ejects the metal from underneath it up the channel *t*², into the chamber *u*, and thence to the mould-block. When the mould-block has been charged, the re-acting springs *p*¹, and *p*², draw forward the horizontal slide and mould-block,—thereby releasing the levers *j*, *k*, and *l*, and allowing the mould-block to open, when, in consequence of the downward inclination of one end, the type falls from it into a pan or box, placed to receive it.

The patentee claims the employment of the horizontal slide, having a mould-block, for casting types, attached thereto, and levers *j*, *k*, and *l*, and spring *m*, spring-holder *m*², and matrix-lever *o*, and the oblique guide *h*, on which the horizontal slide runs, in combination in form and manner and for the purposes above set forth. Also the employment of the cams *r*, and *v*, on the main shaft, and the levers operated upon by and through them, in combination with the plunger, and well and stopper, and nipple-stopper chamber, in a type-casting metal bath, for the purpose above set forth. And, Lastly,—the combination and arrangement of all the foregoing parts, to make and operate a type-casting machine, as above set forth.—[Inrolled October, 1850.]

To RICHARD JOHNSON, of Manchester, in the county of Lancaster, wire-drawer, for certain improvements in annealing articles of iron and other materials.—[Sealed 31st January, 1851.]

THESE improvements consist in an arrangement of annealing pot or oven, suitable for receiving wire and other articles required to be annealed,—the peculiar feature of the invention being the employment of one or more flues, situated within the vessel containing the articles to be operated upon.

In Plate XIII., fig. 1, is a vertical section of an annealing oven, arranged according to this invention, and applicable particularly to the annealing of wire. In the outer part *a*, of the oven, composed of masonry, are formed (in this instance) three openings *b*, provided with fire-doors and plates, of the ordinary construction. These openings communicate with an interior chamber *c*, within which are placed, radially, a

number of fire-bars *d*, resting, at their inner ends, upon a foundation-plate *e*, supported by masonry *f*. The foundation-plate *e*, is provided with a circular groove *g*, in which the lower end of the chamber *A*, intended to contain the articles to be annealed, is placed,—the joint being made air-tight by the introduction of sand or other material. In the centre of the plate *e*, is formed a circular opening *h*, provided with a projecting part, in which the lower end of a tube *i*, constituting a flue, is placed, and the joint made air-tight by sand or other material. The upper part of the tube *i*, has a groove formed therein at *j*, to receive a flange *k*, having a projecting part upon its outward periphery, so as to form an annular cavity;—such flange *k*, being formed in two parts (as shewn in the detached views, figs. 2, and 3), to facilitate its removal. Within the cavity, thus formed, is placed a circular flange *l*, projecting from the under side of a lid *m*, which closes the upper part of the chamber *A*. The outer periphery of the lid *m*, rests upon a series of rings *n*, which fit into a socket of the chamber *A*. The object of using these rings is to obtain the means—by increasing or reducing their number—of causing the lid *m*, to occupy a higher or lower position, and thus compensate for any unequal expansion of the chamber *A*, and tube *i*. The orifice of the lid *m*, is larger than is necessary for the admission of the tube *i*; and within the space thus formed, is placed a ring *o*, provided with a flange, which projects over a cavity formed in the lid,—the interstices between these parts being filled with sand, or other material, to prevent the admission of air. Upon the exterior masonry is fixed a circular flange *p*, which receives a cover *q*.

When it is desired to charge this apparatus, the covers *q*, and *m*, are to be withdrawn, and the two portions of the flange *k*, removed; the wire or other articles may then be placed within the chamber *A*,—the coils (if the former description of goods be operated upon) being disposed around the tube *i*; after which, the several parts being adjusted, as shewn, the admission of air will be prevented. The fires being then lighted, the products of combustion will rise through the chamber *c*; and, being unable to escape at the top, by reason of the cover *q*, will pass downwards through the tubular flue *i*, and thence through the opening *h*, to the chimney flue *v*. In order to promote the combustion of smoke and gases, there is formed over each fire-place an opening *r*, which communicates with a circular passage *s*, open to the chamber *c*, through the medium of a number of perforations *t*: by this arrangement, atmospheric air will flow

through the openings *r*, and thence through the chamber, and perforations *t*, so as to mix with the smoke and gases, and effect their combustion. Suppose the vessel charged with bundles of wire, and the process of annealing completed, the covers before described are to be lifted off; and it will also be necessary to withdraw the tube *i*, in order the more readily to remove the articles: for this purpose, a projecting part *u*, is formed in the interior to provide the means of obtaining a hold. Figs. 4, and 5, are side and top views of an apparatus employed for removing bundles of wire from the pot in which they have been annealed. To a ring 1, are attached three arms 2, each of which is provided with a centre-pin 3, upon which there is mounted a catch 4, capable of turning upwards upon the said pin, in the direction of the arrow, fig. 4, but prevented from turning in a downward direction by the end 4*, arriving in contact with the under side of the arm 2. In stowing the bundles of wire, occasional intervening plates of metal, having a central orifice, large enough to receive the tube *i*, are placed so as to divide the articles into several lots. When it is desired to remove the wire, the covers are to be lifted off, and the flue or tube *i*, withdrawn, as before described; and then the ring 1, of the apparatus shewn at fig. 4, is to be attached to any ordinary hoisting tackle, and lowered until the catches 4, have dropped through the orifice of that plate which is nearest to the top. This dropping through will be effected by the catches 4, turning upon their centre-pins; and they will then again fall downwards, so as to project beyond the periphery of the orifice of the plate, and occupy the position represented at fig. 6. The hoisting tackle being then put into operation, the plate (which is marked 5, in fig. 6), and that portion of the wire above it, will be lifted, and withdrawn from the pot.

Fig. 7, exhibits a modification of the arrangement before described. In this instance, the annealing pot *A*, is made in three portions, capable of being charged separately, and placed one on to another (so as to form an entire apparatus), and also of being removed independently. The lower portion, after being charged, has a ring of metal *k*, placed within a groove formed upon the periphery of the central flue *i*; a cover *m*, is then applied, and another ring *k'*, similarly placed in a corresponding groove; and the portion or pot, so arranged, is placed upon a foundation-plate *e*,—a socket at its lower part fitting upon a central projection *e'*, as shewn. Above this portion or pot, other pots are, in like manner, placed,—the whole forming three distinct chambers, but tra-

versed by a common internal flue. In this manner, any required number of distinct pots may be combined, and placed within a heating apparatus, similar to that shewn at fig. 1, or of any other convenient arrangement; and, when the required process of annealing shall have been completed, they may be removed separately by the apparatus shewn at figs. 4, and 5, or by other convenient means; for which purpose, projections *u*, are left within the flue *i*.

In conclusion, the patentee remarks, that although he has shewn but one interior flue, yet, if desired, two or more may be employed; and other variations may be made in the arrangement and construction without departing from the principle of his invention,—that which he claims being the use of a flue or flues situated in the interior of annealing pots or ovens.—[Inrolled July, 1851.]

To JOHN GRANT, of Hyde Park-street, in the county of Middlesex, for improvements in heating and regulating temperature.—[Sealed 24th October, 1850.]

THIS invention consists in a method of heating boilers, so as to obtain a more uniform supply of fuel, and, consequently, a better regulation of the temperature.

In Plate XIV., is exhibited so much of a steam-boiler as is requisite, in order to explain this invention: the form of the boiler may be varied. *a, a*, are the fire-bars (which the patentee prefers to form in sections for boilers of large dimensions), making up the conical form of grating shewn, and supported at intervals by projections *b*,—a space being left at the outer edge for the passage of air, and for the dust and cinders to fall through. The fuel-chamber *c*, is kept full of fuel, which, descending, will keep up a regular supply to the fire, and, by reason of the conical form of the grating, will be evenly distributed upon the fire-bars. *d*, is a flue, surrounding the fuel-chamber *c*, into which the products of combustion pass up from the fire between the connecting pipes *e*, and thence proceed through the flue *f*, to the chimney. The front part of the boiler is to be kept off the floor, so as to admit a supply of air below the fire-bars, and to serve as an ash-pit; and there should be sufficient space between the bars to admit of a rake being introduced between them from below. By this arrangement, the fire-doors heretofore applied to boilers are dispensed with, and the whole of the fire and the chamber leading to it are surrounded by water; so

that the heat evolved will be taken up by the surrounding water more advantageously than when fire-doors and furnaces of the ordinary construction are used.

The patentee claims the mode, above described, of applying heat to water or fluids in boilers, and regulating the temperature thereof, by immersing the furnace, for the purpose of heating liquids, either in vessels of iron, wood, or other material.—[*Enrolled April, 1851.*]

To JOHN FEATHER, of Keighley, in the county of York, worsted spinner and manufacturer, and JEREMIAH DRIVER, of the same place, iron and brass-founder, for certain improvements in screws.—[Ssealed 9th February, 1852.]

THIS invention relates to screws used in machinery for the purpose of propelling any fibrous substance or substances through such machinery in any process which such substance may be required to undergo; and it consists in the use of screws adapted for propelling such substance at various rates of speed during its passage through the machine: the screw may be made with single, double, or treble threads.

The patentees remark, that, in propelling any such substance through a machine (as in the process of combing wool), the ordinary practice has been to use a screw of uniform pitch; and, in consequence of such uniformity of pitch, the machine has not been able to do its work with one pitch of screw and length of gill-combs, to keep both long and short wool in their proper place. That is to say, firstly, if the screw be a fine one, calculated to keep the short wool in its proper place, it must of necessity be a short one; because the front roller cannot draw the wool through the combs when the screw is both long and fine; and frequently the long end of the sliver gets bagged together at the back of the combs, and slips over the top of the combs,—thereby making lumps in the end or sliver. Secondly, if the screw be a coarse one, calculated to keep the long wool in its proper place, the space between the combs and the nip of the front roller varies so much that the short wool slips through the front roller, and thereby makes lumps in the end or sliver. Now, the patentees vary the pitch of the screw, so that it is at any part or parts thereof coarser than at other part or parts, whereby the fibrous substance can be propelled at different rates of speed, while the screw moves at one and the same rate; and this enables the machine to do its work with a much greater length of

combs, and keeps both long and short wool in their proper place.

In order to vary the pitch of the screw, the rest or cutter of the lathe is moved by tappets, or by "scrowls," varying in length and shape according to the different variations in the screw required to be produced. From one screw, so made, others, with the same variations of pitch, can be made in the ordinary manner.

The patentees remark, that they are aware that accelerating screws of varying pitch, finer at one end than at the other, for the purpose of obtaining a progressively increasing speed, have been before used; but they claim a variation or variations in the pitch of screws, as above mentioned, for the purpose of varying the rate of speed as may be desired. In conclusion, they state, that, having described the nature of their invention, they would have it understood that what they claim is, the manufacture of screws with a variation or variations of the pitch (as above mentioned), so that the pitch of such screws shall be coarser at any part or parts than at other part or parts thereof, as above described.—[*Inrolled April, 1852.*]

[If there were any novelty in the use of screws with varying pitch for propelling the gill-bars, the improvement could not be protected under the title above recited; for it is not the manufacture of screws with varying pitch which the patentees desired to protect, but the application of such screws to screw-gill machinery.—Ed.]

To WILLIAM HODGE, of St. Austell, Cornwall, printer, for improvements in the manufacture of glass, china, porcelain, earthenware, and artificial stone.—[Sealed 2nd October, 1851.]

THIS invention is stated to consist in the employment of hornstone porphyry (also called elvan or freestone), in the manufacture of glass, china, porcelain, earthenware, and artificial stone.

For the manufacture of glass, the elvan is reduced to a fine powder, which is used in combination with the materials ordinarily employed; and, owing to it being a natural combination of silex with potash and alum, it will be found highly useful in such manufacture. As the elvan varies in the respective quantities of its constituents, different specimens require to be used in different proportions: thus, when the elvan contains a large proportion of silex, a larger quan-

tity of fluor spar is necessary to flux it into glass; and when it contains a large proportion of potash and alum, it requires a smaller quantity of fluor spar. These observations apply when potash, lime, lead, and other fluxes are used, according to the descriptions of glass to be made; and the manufacturer will adjust the quantities of the siler and the flux according to the proportions of the matters contained in the elvan employed. The elvan does not require to be washed, except for very fine qualities of glass.

In the manufacture of china, porcelain, earthenware, and artificial stone, the elvan is either used alone or combined with the other materials commonly employed; and, for the finer classes of these manufactures, it is ground and washed. In the manufacture of earthenware the elvan is taken in the state of powder, and brought into a plastic state by the addition of water; and articles may be made wholly of the elvan, which will be found to have all the plasticity of the clay commonly employed, and may be treated and used in like manner thereto: when finished, the articles will be found much harder and closer in texture than earthenware in general, and present a better appearance. When mixed with china clay, the elvan will be found to improve the same,—giving a more stone-like appearance to articles made of such combination: the proportion of elvan may be varied according to the effect desired to be obtained.

Elvan is also applicable in the manufacture of china and porcelain, as a substitute for china stone, china clay, and felspar, for making both the bodies and glazes. Elvan will be found more plastic than china stone, when prepared,—enabling the manufacturer to use it in place of china and other clays; and its stone-like character renders it superior in the manufacture of porcelain and china, where such quality is desired: it is to be employed with china stone or clay and felspar in greater or less quantities, according as it is desired to give the clay and felspar more or less of this peculiar character. The patentee states that although he has only spoken of using elvan with other matters in a plastic state, such material and combination of materials are also capable of being employed in a dry state, in like manner to what is now practised when using clays in making china articles by dies and pressure, by what is known as the dry process of manufacture. For glazes, the elvan is to be employed in like manner to that adopted when using china stone and felspar.

In making artificial stone by employing elvan, it will generally require little or no preparation. When found sufficiently

fine in its crude state, it is brought to a plastic state, and moulded into articles of the desired shapes ; and these articles, after being dried, are baked in a kiln or furnace, in like manner to earthenware. In manufacturing artificial stone, the elvan may be combined with flint, sand, quartz, granite, or other kind of stone, broken down when necessary to a state of powder, or to a granular condition.

The patentee states, that he does not confine himself to the above details, or the manner of using the above-mentioned material. He claims the application of hornstone porphyry, also called elvan or freestone, in the manufacture of glass, china, porcelain, earthenware, and artificial stone.—[*Inrolled April, 1852.*]

To THOMAS CUSSONS, of 51, Bunhill-row, in the county of Middlesex, for improvements in ornamenting woven fabrics for bookbinding.—[Sealed 2nd October, 1851.]

THE subject of this invention is the ornamenting of woven fabrics for use in bookbinding by the process of "marbling," heretofore applied to paper by bookbinders.

The woven fabrics most suitable for being treated according to this invention are those which have been stiffened and then glazed by hot or cold pressure, like those commonly employed by bookbinders ; although it is not absolutely necessary that the fabrics should be stiffened before being ornamented according to this invention. The woven fabrics to be treated may either be white, or dyed or prepared of any color desired for the groundwork ; and, after being stiffened and glazed, or glazed only, they are subjected to the process of marbling, as follows :—The operator prepares his trough with liquid, as when for marbling paper, and throws or deposits the color, combined with metallic substances or not, on to the surface,—using one or more colors according to the effect desired ; he lays the woven fabric, with the glazed surface downwards, on to the color, in the same manner as when marbling a sheet of paper ; he then removes the woven fabric from off the floating color on to a rod (in the same way that the paper is usually removed), and hangs it up to dry ; and, when dry, he glazes the fabric, in order to obtain a smooth and bright side.

In some instances, instead of placing the woven fabric on to the floating color, the operator uses a comb or rake, in the manner well understood ; and, in other cases, instead of a comb or rake, he employs a frame with numerous points or projections, which descend below the surface of the floating color ; so that, on the frame being moved, each point or pro-

jection produces a curling effect. From the foregoing explanation, it will be clearly understood, that like processes are to be resorted to for ornamenting woven fabrics as for paper, when like effects are required to be obtained. If the colors employed should be found to interfere with the subsequent process of glazing, the fabric is to be sized after the operation of marbling.

In conclusion, the patentee declares that the novelty of his invention consists in combining the process of marbling with woven fabrics.—[Inrolled April, 1852.]

Scientific Notices.

HAY-MAKING MACHINES, AND HORSE AND HAND- RAKES IN THE GREAT EXHIBITION.

AGRICULTURAL IMPLEMENTS, although properly classed among labor-saving machines, have one important element which is not possessed, to anything like the same degree, by any other class of mechanical contrivances; while estimating, therefore, the relative merits of hand and machine labor, this element should never be lost sight of by the agriculturalist. In concluding his Report upon the Agricultural Implements of the Great Exhibition, Mr. Pusey, a great authority on such matters, makes reference to this fact where he states, that "machinery has given to farming what it most wanted—not absolute, indeed, but comparative certainty." Now, the reason why machinery has been enabled to effect this important alteration is obvious enough; for, unlike other manufacturers, to whom the word "seasons" has reference only to demand—not to supply—the farmer's operations are circumscribed by occurrences over which he has no control. Thus, for instance, in operating with the machines which we are immediately to notice, he must avail himself of the rays of sunshine when they come, and, without delay, present his mown crop most eligibly to that grateful influence, lest the opportunity should pass, and be succeeded by drenching showers. Expedition, therefore, is most essential, even though it were attained at an increased cost. For this reason it is necessary to consider to what degree certainty of success (as respects speed of working) may be approached by new adaptations of machinery, as well as what is the positive saving over the cost of manual labor, before a proper estimate can be arrived at respecting the relative advantages derivable

from hand and machine labor. We have been led to make these remarks from recently witnessing the imbecile attempts at cultivating the soil which still obtain in many parts of the country, in spite of the extended use of machinery; and we cannot but think that the retention of these ancient practices, which give a new coloring to rural simplicity, must be owing to an entire forgetfulness of the promptitude that is so essential to success at certain periods in farming operations.

HAY-MAKING MACHINES.

These machines, as the term implies, are substitutes for manual labor in the operations of scattering and turning the cut grass, in order that the sun and air may freely act upon it, and convert it into hay. The hay-making machine, as generally constructed, consists of two circular frames, carrying several rows of teeth or tines, and fixed on tubular shafts, which are mounted on a horizontal spindle, in such manner as to be capable of revolving independently of each other. The spindle is supported at each end by a moveable circular casing, carried by the framing of the machine, which is fitted with a pair of shafts for a horse, and is supported by a pair of travelling wheels; and, from the axles of such wheels, motion is transmitted to the circular tine-frames (by wheel-work within the circular casings), so as to cause them to revolve in either direction. The teeth or tines are slightly curved; and the bar that carries each row is held in the proper position by a spring, which permits the tines to yield to any inequality of the surface, and also admits of the tines being turned down level with the periphery of the circular frame, when they are not required to be in action. The tine-frames revolve, as before stated, in either direction, according to the adjustment of the parts that communicate motion from the running-wheels thereto. When the machine first operates on the grass, the tine-frames have what is termed the forward action (rotating in the opposite direction to the running-wheels); and, as the implement is drawn across the swathes, the tines take up the grass in like manner to the prongs or tines of a fork, and toss and scatter it about. After the grass, thus strewn over the field, has lain for a short period, the machine is again drawn over it; but this time the motion of the tine-frames is reversed, and the grass is subjected to the back action of the tines, which, instead of tossing it over, now throw it lightly backwards, and leave it in such a loose state that the sun and air can act freely upon it and dry it quickly.

In addition to the combined mowing and hay-making machine of Messrs. Beckford and Gosling, described at p. 303, and a model of a hay-maker, contributed by M. De Porquet, there were three full-size hay-making machines in the Exhibition, from the manufactories of Messrs. Smith and Co., of Stamford—Barrett, Exall, and Andrewes—and Wedlake and Co. The hay-maker of Messrs. Smith, which was included in the award of a prize medal, possesses some important peculiarities. The tine-bars are commonly attached to and supported by a circular frame at the middle of their length; but, in this implement, they are supported at their extremities, and are therefore less liable to be injured when in action. The apparatus for reversing the rotation of the tine-frames, and for raising them out of action, is so arranged, that the attendant can effect either of these objects without leaving the side of the horse. The rotation of the tine-frames, and the reversing action, is effected as follows:—Each travelling wheel is fixed on the outer end of a short axle, carried by the framing of the machine; and, on the inner end, within the circular casing that supports the spindle of the tine-frames, a toothed wheel is keyed, which, when the grass is to be subjected to the forward action of the tines, gears into a pinion on the end of the tubular shaft that carries the tine-frame, and thereby causes the frame to rotate in the opposite direction to the travelling wheel. When it is desired to reverse the direction of rotation of the tine-frames, the attendant, by means of a lever, shifts the tubular shafts endwise for a short distance: this movement takes the pinion out of gear with the toothed wheel, and throws it into gear with a second pinion, fixed on a boss which carries another pinion in gear with the toothed wheel, and so effects the desired change. The lifting of the tine-frames out of action is effected in the following manner:—The circular casing, at each side of the machine, that supports the spindle of the tine-frames, is capable of turning or sliding around the axle of the running-wheel, so as either to raise or lower the spindle, which is carried by a projecting part of the circular casing. In order that the casings may be turned simultaneously, a lug or ear in the periphery of each is connected by a rod with a short crank; which cranks are fixed on the ends of a horizontal shaft, extending across the front part of the machine. This shaft carries a worm-wheel or toothed sector, that gears into a small worm or endless screw, having a handle on one end of its axis; and, by turning this handle, the circular casings will be made to slide round, and either raise or lower the spindle of the tine-frames.

HORSE AND HAND-RAKES.

The uses of horse-rakes and drag-rakes are somewhat various; as they are applicable for collecting the hay which has been made by hay-making machines or by hand; also for raking barley and other corn stubbles, couch or twitch grass, &c.; clearing grass land from moss, &c., preparatory to top dressing; and for raking in seed and manure. Horse-rakes consist of a long narrow frame, carried by a wheel at each end, and furnished in front with a pair of shafts for a horse; this frame supports a horizontal shaft or spindle, which receives the socket-ends of a series of rods or bars that form the stems of the tines or teeth of the rake; so that the several tines are capable of rising and falling independently of each other, as they are drawn over the ground; and the whole of the tines are elevated at intervals, in order to discharge the quantity of hay which they have collected, by lifting a bar that either extends across beneath the whole of the tine stems, or else is placed above, and connected by small chains with the several stems. The arrangement of apparatus for lifting the tines varies in the implements made by different makers; and this in fact constitutes the chief point of difference between their respective implements. In some horse-rakes, manufactured upon the old plan, the tines are affixed to one common bar or rake head, and are therefore incapable of rising and falling separately, to accomodate themselves to irregularities of the surface of the soil. Hand drag-rakes differ from horse-rakes chiefly in being of lighter construction, and having a handle by which they are drawn, instead of a pair of shafts.

A horse-rake, exhibited by Messrs. Howard, of Bedford, was included in the award to them of a prize medal. The frame of this rake has two short upright bars at the front, to which the curved bars, that connect the shafts to the frame, are jointed; a part of each curved bar extends downwards below the joint, and is shaped like a quadrant; in each quadrant several holes are pierced, to receive a pin, which enters a corresponding hole in each of the upright bars; and thus the frame is fixed in any desired position with regard to the shafts, so that the tines (which are sickle-shaped) may be made to rake upon their points, or may be set more or less off the ground. The bar by which the tines are raised is supported by arms from the spindle of the tines; a curved prolongation of the middle arm projects forward from the spindle, and is connected by a link-rod with a lever, which is jointed at the forward end to the cross-bar of the shafts; and there-

fore, on the hind end of the lever being pulled down, the bar will rise and lift the tines.

Messrs. Smith and Co., exhibited a balance-lever horse-rake, which was included in the award of a prize medal. The bar that lifts the tines is affixed to the hind ends of two bent levers, which are mounted, at the bend or angle thereof, upon the spindle that carries the sockets of the tines; the forward ends of the levers are curved, and furnished with weights, which serve to counterbalance the weight of the tines and assist in raising them; and the curved ends of the levers are acted upon by two short curved levers, affixed to a horizontal shaft at the front of the implement, which also carries a long lever handle; so that, by pulling down this handle, the tines are raised.

The same firm also contributed a lever hand-rake, having spring steel tines, connected by sockets with a horizontal spindle at the front, so as to rise and fall independently of each other, in like manner to the tines of the horse-rake. The bar for lifting the tines is carried by the hind ends of a pair of right-angle levers, mounted at the angle, on the spindle of the tines, and united at their forward ends to a handle.

In the horse-rake made by Mr. J. C. Grant, of Stamford, the bar for raising the tines is placed above instead of beneath the tine stems, and they are severally connected thereto by short chains. The bar is attached to two straight levers, which turn on axles carried by two arched pieces, affixed to the front and back bars of the frame; and the other ends of such levers are connected by short link rods with two long bent levers, which are jointed to the front bar of the frame, and are united at the back by a cross-bar or handle: by depressing the handle the tines are raised, and the hay or other matter collected by them is discharged.

In Messrs. Garrett & Son's horse-rake (of which they exhibited a model) the tine stems are severally connected by short chains to a cross-bar above, affixed to the hind end of two straight levers, which are connected at their front ends to the spindle that receives the sockets of the tine stems; from the cross-bar two chains are carried upwards and attached to two excentric pulleys, mounted on a horizontal shaft or spindle, which is furnished with a lever handle projecting backwards; by pulling down which, the pulleys will be caused to turn, wind up the chains, and thereby elevate the cross-bar and tines. The spindle or axis of the tine stems is supported by bracket pieces and upright rods, capable of sliding in sockets affixed to the framework of the

implement; and thus the spindle may be raised or lowered, so as to alter the inclination of the tine stems, and thereby cause the tines or teeth to rake lighter or heavier.

The bar for raising the tines in Messrs. Wedlake & Co's horse-rake is connected to the several tine stems by short chains, and suspended by two other chains from the front ends of two weighted bell-crank levers, which are mounted at the middle of a horizontal shaft, supported by upright standards from the back bar of the frame: to this shaft, between the two levers, is affixed a long handle, by which it can be rocked, for the purpose of lifting the tines.

In an implement exhibited by Messrs. Holmes and Son, of Norwich, the lifting bar is placed beneath the tine stems, and supported by arms from the same spindle which carries the stems; and it is suspended by chains from excentric pulleys, in like manner to Garrett's rake. In order that the height at which the frame is supported by the running wheels may be adjusted, the short axle of each wheel is fixed to a rack-bar, into which a pinion gears; and, by means of a winch handle, the pinion is caused to turn, when it is desired to raise or lower the rack-bar to which it belongs.

Messrs. Allen and Co., of New York, contributed a revolving horse-rake, composed of a long straight wooden bar, wherein are inserted numerous straight tines or teeth of wood, which project an equal distance from each side of the bar, and thus form two sets of rake teeth. The rake-bar is attached to a light wooden frame (to which the horse is yoked) in such manner as to admit of it turning freely; and it is also attached in like manner to two bars, which are connected at the top by a cross-bar or handle, whereby the attendant guides and supports the rake. Pendent from the last-named bars is a small swinging frame, which rests against the front side of the uppermost set of tines, and thereby causes the lower set to stand at a suitable inclination. When it is desired to discharge the mass of hay that has accumulated in front of the rake, the swinging frame is raised, and the rake-bar then turns half round, releasing the hay, and bringing the other set of tines into action. A strip of iron, on each of the bars that carry the handle, catches against a short projecting iron nib or shoulder on the rake-bar, and prevents such bar from turning in the reverse direction when there is no hay pressing against it.

This completes our notice of field implements displayed in the Great Exhibition.

INSTITUTION OF CIVIL ENGINEERS.

April 27th, 1852.

The paper read was, "*Railway Accidents—their cause and means of prevention; detailing particularly the various contrivances which are in use, and have been proposed; with the regulations of some of the principal lines.*" By Captain MARK HUISE, Assoc. Inst. C.E.

The author first considered those points connected with the road, and the machinery employed upon it, from which loss of life, and injury to person and property, most generally arose. With regard to the road, or permanent way, from which fewer accidents occurred than from any other cause, its complete effect-iveness was the basis of all safety in railway travelling; and, for keeping it up, constant vigilance was necessary, especially when any great and sudden change of weather took place, as then the weak points were sure to shew themselves. It was a very rare occurrence for trains to run off the lines; and when they did so, it was more generally due to obstructions designedly placed on the line than to any neglect of the superintendents or the plate-layers. It was little suspected how frequent, how ingenious, and how varied the attempts had become to inflict a fearful injury by these means; and though, providentially, but comparatively trifling damage had resulted from such causes, yet it was lamentable to find, that, in addition to all ordinary risks, so diabolical a mode of wreaking a petty vengeance, or gratifying a mischievous disposition, had to be guarded against. Of late the punishment for such offences had been made more severe; and it was to be hoped that this would have the effect of lessening their number. Owing to the rapid development of the traffic—and particularly of the heavy goods traffic—on the main arterial lines of the country, increased siding accommodation had become necessary. In the case of the London and North-Western Railway alone, upwards of fifty-three miles had been laid down within the last few years; although, by multiplying points and crossings, this had, *pro tanto*, increased the liability of accident; for it might be received as an axiom, that anything which broke the continuity of a rail, tended to produce danger. As, however, there were no means of avoiding these frequent "turns out," judicious regulations, combined with effective signals, must be relied on; and now that facing points were reduced in number, the liability to danger had been diminished. The use of self-acting switches was attended with evils of no trifling magnitude, and many accidents had occurred from reliance on them: indeed, as a general rule, machinery to supersede personal inspection and manipulation was fraught with danger.

With respect to the rolling stock, it appeared, from a return

of one thousand cases of engine failures and defects, within two years, on the London and North-Western Railway, that burst and leaky tubes nearly doubled any other class of failure; and that these, with broken springs and broken valves, amounted to one-third of the whole number; and though they caused no direct danger to the public, yet, as producing a temporary or permanent inability of the engine to carry on its train, they might be the remote cause of collision. The passenger carriage, from its perfect manufacture, presented almost complete immunity from accident; for, during the last four years, out of the large stock of the London and North-Western Railway, only six wheels had failed; and though, at first, some noise and alarm had been experienced from heated axles, yet, by the recent introduction of the patent axle-box, it had been much reduced. The same praise could not be bestowed on the merchandise waggon; as in no portion of the system has so little improvement been made: the fracture of axles was frequent—the mode of coupling very defective; and the want of spring buffers, or even of buffers of the same height and width, rendered the destruction of property enormous. No loss of life from fire, either from heated coke, or spontaneous combustion, had occurred to a passenger train; but there had been some narrow escapes. These, and other circumstances, had led many persons to suggest various contrivances for communicating between the passengers, the guard, and the engine-driver, almost all of which were identical in principle, consisting of a connecting wire or rope: this plan had been tried, and failed. A more feasible and favorable one was that recommended by the Railway Commissioners—which was to continue the foot-boards, so as to form a narrow platform from end to end of the train; but a committee of railway officials had subsequently expressed their unanimous condemnation of the measure. The plan now adopted on the London and North-Western Railway was, for the guard's van, at the end of the train, to project about a foot beyond the other carriages; so that the guard, looking through a window in this projection, might notice the waving of a hand or a handkerchief: this was, of course, useless at night.

All these causes, however, did not produce a tithe of the accidents which resulted from a want of attention to signals, and a neglect of regulations, which of all sources of danger were the most prolific. Railway stationary signals had been greatly improved of late years; and the introduction of the lofty semaphores, and the auxiliary signals, really left little to be desired. Besides these, there were the hand signals, to be used by the guards in case of stoppages between stations, and the detonating signals, to prevent collisions during a fog: which latter had supplied a deficiency that had been experienced; and they were found to answer exceedingly well. The Electric Telegraph had greatly facilitated working under variable circumstances; and so beneficial had its effects been, that, during the year 1851, out of

7,900,000 passengers, or nearly one-third of the population of England, who had travelled over the London and North-Western Railway, only *one* individual had met with his death (from which casualty the author also suffered); and this was the effect of the gravest disobedience of orders. In the six months during which the Exhibition was open, 775,000 persons were conveyed by excursion trains alone, in 24,000 extra carriages, all centering in a single focus, arriving at irregular hours, and in almost unlimited numbers, from more than thirty railways, without the most trifling casualty, or even interruption to the ordinary extensive business of that line.

The author thought undue importance had been attached to the question of irregularity in the times of the trains, as an essential element of safety; for, with perfect signals, and a well-disciplined staff, no amount of irregularity should lead to danger; but, on the contrary, it should, to a certain extent, by its very uncertainty, induce increased vigilance, and therefore greater safety. Accidents very rarely happened from foreseen circumstances, but generally from a simultaneous conjunction of several causes; and each of these was provided for as it arose. The statistics of railways, and the periodical publication of the Government returns, drew public attention very pointedly to the aggregate of accidents; but it was believed, that if due regard were had to comparative results—if the accidents to steamers, or in mines, to omnibus passengers, or even to pedestrians, were as carefully recorded—that then, whether as regarded the ease and celerity of transit, or the facility of conveying numbers, the railway system, even in its present state, would be found to be incomparably safer than any other system in the previous or present history of locomotion.

May 4th.

The discussion was renewed on the papers by Mr. BRAITHWAITE POOLE (Assoc. Inst. C.E.) and Captain HUISE (Assoc. Inst. C.E.), on the "*Economy of Railways*," and on "*Railway Accidents*," and was continued throughout the evening.

The principal points in the working of railway traffic were carefully discussed; and the modifications which had been, by degrees, introduced, were noticed. The necessity for a certain amount of uniformity of construction of the rolling stock, as far as accordance between the centres of the buffers of all carriages likely to be brought together to make up the trains, was admitted; but any attempt to enforce complete uniformity was strongly deprecated.

The proposition for dividing the railway kingdom into four parts, and amalgamating the rolling stock for each division, was contended to be impracticable and impolitic.

The question as to the prudence of railway companies be-

coming manufacturers of engines and carriages, and even, as was once contemplated by the London and North-Western Railway, rolling their own rails, was also strongly argued; and it was contended, that such an application of the funds of a railway company was not prudent or advantageous; as repeated instances had been shewn that companies could not compete with individuals in economy of manufacture. Still, however, there were many good authorities who contended, that as long as a railway company did execute its own repairs, it would be found economical to fill up the time of the men and employ the tools in making a few engines, and only purchasing the stock required for the new lines or branches.

The greater care exercised in the purchase of materials, and in the manufacture of certain parts—such as axles and wheels—was shewn to have produced excellent results: only four iron wheels, and two wooden wheels, had broken under passenger carriages in four years on the London and North-Western Railway, where the wooden were rapidly superseding the iron wheels. Some curious results of manufacturing locomotive engines were given; and it was shewn, that one great firm, the goodness of whose productions was generally admitted, had actually incurred a heavy loss in building engines since 1848;—having, however, previously to that time, manufactured with profit. How much more likely would a railway company be to make heavy losses, than a manufacturer, who could devote his whole attention and energy to the economical conducting of his establishment?

It was admitted that the maintenance of way, making gas for the stations and shops, and a few other matters, might be legitimately retained in the hands of a railway company; but it was contended, that the main objects to be obtained would eventually be, the leasing the working, as well as the maintenance of stock, of all lines, by individual contractors; and then that capital accounts would be closed, and the shareholders would ascertain their actual position.

The discussion—which had taken a commercial turn, instead of entering into the question of railway economy, or of railway accidents—occupied the whole time of the meeting, to the exclusion of any other subject.

Mr. Ebenezer Goddard, Assoc. Inst. C.E. (of Ipswich), exhibited, in the library, a small portable asbestos gas stove, for heating apartments, of great simplicity and portability—the apparatus being contained in a box 12 inches by 9 inches, and 3½ inches deep; also, a protected gas-burner, of novel construction, for gas-cooking stoves, in which the holes were not liable to be choked up.

INSTITUTION OF MECHANICAL ENGINEERS, BIRMINGHAM.

April 28, 1852.

A supplementary paper, by Mr. JAMES SAMUEL, of London, was read, in continuation of the paper read at the former meeting, on January 28th:—

*On a Continuous-expansion Steam-engine.**

After briefly noticing the description given in the former paper of the continuous-expansion steam-engine, the present paper proceeded to explain three approximate indicator diagrams which accompanied it; and these diagrams were exhibited in order to compare the relative amount of duty obtained from the same quantity of steam when employed in ordinary engines and in the continuous-expansion engine; and they had been drawn out from comparison with actual indicator diagrams, taken from locomotives, so as to allow correctly for the pressure of the exhaust and the compression, and the wiredrawing of the valve. The diagrams are numbered 1, 2, 3.

No. 2, shewed the performance of the steam in an ordinary engine, with two 15-inch cylinders = 353·4 square inches area, and 24-inch stroke,—cutting off the steam at 8 inches, or $\frac{1}{3}$ of the stroke. The pressure of the steam was 100 lbs. per inch above the atmosphere, but reduced by wiredrawing to 92 lbs. at the point of cutting off; so that the actual quantity of steam supplied to the two cylinders for one stroke, was $353·4 \times 8$ inches = 2827 cub. in. at 92 lbs per inch. The steam was exhausted after having been expanded down to 28 lbs. above the atmosphere, at which pressure it was discharged as the blast. The back pressure was taken at 5 lbs. per inch at full speed—say 40 miles per hour, from the end of the exhaust to the beginning of compression.

The average positive pressure throughout the stroke	=	63·3 lbs.
" " negative " " "		10·1 lbs.

Total effective pressure	53·2 lbs.
--------------------------------	-----------

Total power = 353·4 in. area $\times$ 53·2 lbs. per inch ...	=	18,801
--	---	--------

No. 1, shewed the performance of the same steam (2827 cub. in. at 92 lbs. per in.) in the continuous-expansion engine. The area of first cylinder was 147·8 sq. in. (or about $13\frac{1}{2}$ in. diameter), and that of the second cylinder equalled 443·4 sq. in. (or about $23\frac{1}{2}$ in. diameter), both being 24-inch stroke, the same as before. The steam was cut off at $16\frac{1}{2}$ inches, or about $\frac{2}{3}$ of the stroke of the small cylinder, and at 1 inch of the stroke of the large cylinder. The steam was expanded in both cylinders down to

* See page 401 ante.

30 lbs. per inch at 2 inches from the middle of the stroke of the large cylinder, when the communication was shut between the two cylinders, and the steam in the first cylinder discharged as the blast, amounting to 44 per cent. of the whole quantity of steam admitted, and at the pressure of 30lbs,—being a little higher than the pressure of the blast taken in the ordinary engine, No. 2, and about half the quantity of steam. The back pressure in the small cylinder was taken at 5 lbs. per inch, the same as in No. 2; but the steam in the second cylinder was further expanded down to 7 lbs. per inch above the atmosphere, before being exhausted, and was reduced nearly to the atmospheric pressure at the end of the stroke,—the back pressure being taken at $\frac{1}{2}$ lb. per inch.

	Small Cylinder.	Large Cylinder.
The average positive pressure throughout the stroke	= 87.2 lbs.	30.8 lbs.
" " negative " "	= 13.8 lbs.	4.9 lbs.
Total effective pressure	73.4 lbs.	25.9 lbs.

Total power,—

1st cylinder, 147.8 in. area $\times$ 73.4 lbs. per inch	= 10,849
2nd cylinder, 443.4 in. area $\times$ 25.9 lbs. per inch	= 11,434

Total 22,333

Then 18,801 : 22,333 : : 100 : 119

Therefore gain = 19 per cent.

Consequently, the power obtained in the continuous-expansion engine is 19 per cent. greater than the power obtained from the same steam when employed in the ordinary engine, when the expansion is carried as far as appears to be found practicable, consistently with the maintenance of a sufficient pressure of blast.

No. 3, shewed the power obtained from the same quantity of steam in a non-expansive engine when the steam was not cut off until 1 inch from the end of the 24-inch stroke: the cylinder was then about 122.9 sq. in. area (or about $12\frac{1}{2}$ inches diameter), containing the same quantity of steam (2827 cub. in., at 92 lbs. per in.) in 23 inches of the stroke, where it was cut off. The back pressure was taken at 5 lbs. per inch, as in the first case.

The average positive pressure throughout the stroke	= 97.0 lbs.
" " negative " " "	= 14.4 lbs.

Total effective pressure 82.6 lbs.

Total power = 122.9 in. area $\times$ 82.9 lbs. per inch ... = 10,151

Then 10,151 : 22,333 : : 100 : 220

Therefore gain = 120 per cent.

of the continuous-expansion engine compared to a non-expansive engine.

In the continuous-expansion engine, although the second cy-
VOL. XL. 3 K

linder is three times the contents of the first cylinder, the average pressure is about one-third,—being 25·9 lbs. compared to 73·4 lbs.; so that the total propelling power of each of the cylinders is very nearly equal, as in an ordinary engine, and no practical objection is occasioned.

The application of the principle to stationary engines was described in the former paper; and it was shewn to be a means of carrying the expansive principle to a greater extent than is practicable in the present engines,—thereby proving an important source of economy, because of the great uniformity in the combined moving power of the two cylinders as exerted upon the crank-shaft in a rotary direction, on account of the cranks being at right angles, and the continuous expansion of the steam in the two cylinders; but in ordinary engines the expansion could not be carried so far, where uniformity of motion was requisite, as in driving machinery, because of the great irregularity in the rotary power that was produced when the expansion was carried far.

The comparative effects were shewn by a series of diagrams, of the variations in the total amount of moving power, or laboring force, exerted in the direction of the rotary motion of the crank, in the continuous-expansion engine, in Woolf's double-cylinder engine, and in the Cornish engine, taking the steam in each case to be admitted at 50 lbs. per inch above the atmosphere, and expanded down to the lowest useful pressure before it is condensed. The following comparative results were obtained:—

	Continuous Expansion Engine.	Woolf's Engine.	Cornish Engine.
Average amount of irregularity in moving power throughout each stroke	100	114	130
Extreme irregularity during the stroke	100	125	134
Comparative amount of work done by the same steam or fuel	100	109	111

The general results of these comparisons being, that the Cornish engine is 11 per cent. and Woolf's engine is 9 per cent. more economical in expenditure of fuel than the continuous-expansion engine, when the expansion of the steam is carried to the extreme limit in each case; but that this economy cannot be obtained practically in those two engines, on account of the great irregularity in their moving power—the average irregularity being, in the Cornish engine, 30 per cent., and in Woolf's engine, 14 per cent. greater than in the continuous-expansion engine,—and the extreme irregularity being 134 and 35 per cent. respectively greater.

Consequently, it appears, that, although the expansion of the steam cannot be, theoretically, carried to so great an extent in the continuous-expansion engine as in the other two engines, yet, from the moving power being so much more uniform throughout the stroke, the expansion can be carried practically to a considerably greater extent; and a greater amount of economy may

be practically obtained, within the same limit of uniformity, in the moving power.

The comparison between the continuous-expansion engine and an ordinary non-expansive condensing engine, in which the steam exerts a uniform pressure upon the piston, from the commencement to the end of the stroke, shews that the variation in the development of moving power throughout one revolution is, in the former case, only 43 per cent., and in the latter, 62 per cent. extreme variation from the average power.

The relative economy of the two engines, or the amount of duty obtained from the expenditure of the same quantity of fuel, in each case, is as 100 to 38; so that the continuous-expansion engine does the same work as the non-expansive engine, with a more uniform moving power, and with 62 per cent. less fuel.

In reply to a question of the Chairman (Mr. Robert Stephenson), Mr. Samuel stated, that the trials made were incomplete; and he had not had an opportunity of taking indicator diagrams from the engines, nor of carrying out the trials sufficiently to obtain comprehensive results suitable for laying before the Institution. One of the engines tried was a goods engine, of the largest size, on the Eastern Counties Railway; the valves only were altered, and the second cylinder was not enlarged. It was only a temporary experiment, which, of course, caused a reduction in the extreme power that the engine could exert; and the object was more particularly to see how the principle could be best carried out in practice, and whether the proposed reduction in the blast could be effected: the result was a saving of 12 lbs. of coke per mile in consumption. The engine performed its usual work during the trial. The engine-driver could work the engine in the ordinary manner up the inclines, by shutting the communication between the two cylinders, or the engine could not probably have taken the load through the trip; but he might use more steam than usual in the one cylinder, by keeping the regulator more open.

Mr. McConnell observed, that he had doubts whether an engine, at considerable speed, using much steam, would get a sufficient blast, if altered in the proposed manner, and would not require the blast-pipe to be reduced,—involving a loss of power from that cause.

Mr. Samuel replied, that in the two engines that had been tried, no difficulty appeared in making steam, and they were not found short of steam. Goods engines, working at slow speed, might perhaps be found the most useful cases for applying the principle. The other engine that had been tried was a passenger engine, in which the second cylinder was made double the area of the first; and it was never found short of steam, though running an express train of considerable weight. The results of the experiments as to economy were interfered with by a defect in the construction of the valves, which were tried with India-rubber packing at the back, as equilibrium valves, and proved leaky

in working; and there was not an opportunity of carrying out the experiment further with valves of the ordinary kind; so that no sufficient results were obtained as to consumption, though, as long as the valves remained in order, the engine contrasted favorably in consumption with other engines of the same class and work. The only definite result obtained was with respect to the sufficiency of the blast, which proved quite satisfactory during the regular passenger-train work of about a month.

Mr. McConnell thought there would be an advantage, in the relative consumption of fuel, from the engine employing less steam with the same boiler, as he considered it was an important source of economy of fuel to increase the heating surface in proportion to the consumption of the cylinders, particularly in the large goods engines.

The Chairman observed, that there was some uncertainty, from the form of the experiment, whether the economy observed was due to an improved mode of employing the steam, or was caused by not over-working the boiler: if less work was performed by the engine, then less steam was wanted from the boiler in the same time, and the smaller quantity of steam would be generated more economically from the same firegrate and heating surface.

Mr. D. K. Clark (of Edinburgh) observed, in reference to the correctness of the conclusions to be drawn from the artificial indicator diagrams that were exhibited, that although they were artificial, they were founded on actual diagrams taken from locomotive engines, and therefore legitimate conclusions could be derived from them, and he considered they might be relied upon. The back pressure in the second cylinder, where there was no blast, had been taken in the diagram at only half-pound per inch, and would, of course, require to be matter of experiment to prove it positively; but he had observed the back pressure as low in locomotives where the valves and ports were properly adjusted; and, in the diagram taken from the Great Britain engine, at fifty-five miles per hour (which was before the meeting), the back pressure was less than half-pound, with a blast-pipe, when the steam was cut off at one-third of the stroke. It had been assumed in the paper, that the steam could not be cut off in practice at less than one-third of the stroke, on account of the blast; but he had found it cut off at only one-fifth of the stroke in engines on the Caledonian Railway, and even less; still, they worked well, and appeared to make steam enough; but then it was certainly down the heavy inclines, where the consumption of steam was small.

The Chairman said there was one novel circumstance in the arrangement of the proposed engine, which did not appear correct in theory: in all the previous double-cylinder engines, the first piston was allowed to complete its stroke before the steam was expanded into the second cylinder; but, in this engine, the steam is passed into the second cylinder at the middle of the

stroke of the first piston,—thereby taking the steam away at the very moment that it is most efficient in the small cylinder.

Mr. Samuel explained, that, at the half stroke of the first piston, the second piston was at its dead point, and began to move very slowly when the communication was opened between the two cylinders, and, consequently, took very little steam whilst the first piston moved through the greater portion of its remaining stroke; but then, as the first piston was getting less effective, and approached its dead point, the second piston came gradually into full action,—making a continuous expansive action, which was the peculiar feature of this engine, instead of the intermittent expansion of the other double-cylinder engines.

Mr. Slate wished some complete experiments should be made on the practical effect of expansion; as he was doubtful whether so much of the theoretical advantage could be obtained in practice as had been supposed. In the present engine, he could not understand the advantage of employing part of the steam at a lower pressure in a larger cylinder, as he thought that would cause the constant resistance of the atmosphere to be more seriously felt. If the strain were employed at the full pressure, say 90 lbs., in the small cylinder alone, the atmospheric resistance would only cause a deduction of one-seventh of the whole power; but if the strain were only at about 30 lbs. pressure in the large cylinder, this deduction for the atmospheric resistance would be increased to one-third of the power. Therefore it appeared to him most advantageous to employ the steam only in the small cylinder, to diminish the proportion of atmospheric resistance as much as possible. He thought the diagrams given, though borne out by the results of calculation, could not be argued from like actual indicator diagrams taken from the engine; and it was very desirable for those to be obtained.

The Chairman remarked, that the pressure of the steam during expansion would be affected by the condensation that always took place to a considerable extent in the cylinder; and the expansion-curve in the theoretical diagrams would, consequently, require practical correction for the condensation and temperature. There appeared to be always some condensation produced when steam was expanded.

Mr. Cowper thought the expansion-curve could be practically laid down from Pambour's experiments, as the actual deviation in practice from the theoretical rate of expansion was very little. He thought there would not be found to be any loss by condensation in a well-protected cylinder; he had not found any condensation to take place in the experiments that he had tried on expansion.

The Chairman said he had always found a condensation take place in expanding steam; and he considered that the heat in steam was not sufficient to maintain all the steam in a gaseous state during expansion; and a portion of it was consequently condensed.

SOCIETY OF ARTS.

March 10th, 1852.

Agricultural progress and implements. By JOHN WILSON, Esq.
F.R.S.E., F.G.S.

THE lecturer, at the commencement of his address, referred to the beautiful process due to M. Balard for the extraction of potash from sea-water, as having relation to agriculture. Potash, he said, is a salt peculiarly essential to vegetable life, in which it holds the same relation as soda does to the animal kingdom. For obtaining it, we have had to rely upon the vegetation of other countries. At present, the shore of the Mediterranean (Marseilles) is the seat of M. Balard's new manufacture, where the low-lying lands offer an extended surface for spontaneous evaporation of the sea-water with which they are constantly flooded. When it has arrived at a certain density, it is removed for the purpose of further concentration: this is followed by a separation of a portion of its constituents—the sulphate of soda and the chloride of sodium. In the bittern, or mother-liquor, is found the potash.

In speaking of the question which is now being agitated among agriculturists, as to whether or not the manufacture of sugar from beetroot can be carried on beneficially in this country, he said that the manufacture progressed slowly at first on the continent; and what was originated by a compulsory edict, now remains in the shape of a thriving and increasing industry, benefitting alike the producer of the material and the consumer of the manufactured products.

Much of this success was attributed to the skill and intelligence which have been brought to bear upon the subject both by the chemist and the manufacturer. We had good evidence of this in the process exhibited by Serret, Hamoir, & Co. (Valenciennes), by which every particle of the raw material was utilized in some way. The staple article, the sugar, was obtained in a remunerating per-centage; the pulp was sold in a hard cake, either to be used as a feeding material or as a manure; the refuse molasses had all its saccharine contents converted into spirit of wine, and then the residuary organic and saline matters separated and sold for distinct purposes. Thus, every particle of the root was converted into a marketable commodity, by which the cost of manufacture was considerably reduced.

In relation to sheep-breeding, the lecturer remarked, that in this country, where our consumption of mutton and of wool is enormous, the relative value of the two products has, of late years, caused the farmer to direct his attention to that which appears to pay him the best—the mutton. On looking at the question in a scientific as well as in a practical view, we shall then see how far our practices are really to our own interests. Wool and flesh have the same elementary composition. The one, however, con-

tains about 12 per cent. of water, while the other contains about 75 per cent.: therefore, one pound of pure wool would require as much nutriment to be assimilated for its production as would suffice for about $3\frac{1}{2}$ lbs. of flesh. An allowance, however, must be made, in our calculation, for the various foreign matters—amounting to from 25 to 30 per cent.—which are always sold with the wool, and separated afterwards from it by scouring: we should then have the cost of wool to the farmer as equal to about $2\frac{1}{2}$ times its weight in flesh. Just at present, their relative prices make the real value of the two about equal; but circumstances connected with our wool-producing colonies render it more than probable that our supplies from them will not be so regular as heretofore; and then, as a consequence, either the quantity must be increased at home, or the prices will rise. If the latter should be the case, the farmer will find that he is manufacturing the wrong material—that the same amount of keep which brings him in a certain return in flesh, would be more productive if converted into wool. This would necessitate a modification of his present practice of encouraging the early maturity of his sheep, and their propensity to lay on fat: both of which are opposed to those healthy secretions so necessary to the formation of wool. The secreting matter itself is diverted from its natural course; and the thick layer of fat immediately beneath the skin induces an abnormal condition, which, as the sheep gets older, is shewn by a diminution in the quantity, and a deterioration in the quality, of wool produced. This result is well known in the market. The average clip of a “teg” is heavier than that of a full-mouthed sheep, and the produce fetches a higher price per pound.

The lecturer next noticed agricultural implements;—in speaking of which, he particularly referred to the subject of reaping-machines, as they are likely to play a very important part in the mechanics of agriculture, and of late have created a great deal of excitement in the farming community. Of these there were three exhibitors—two in the American, and one in the English department: which latter was identical with one of the others—Hussey's. Besides these, there were no less than six models of machines shewn in Class IX., thus demonstrating clearly that, although the machine had not been generally recognized in this country, we were fully alive to the advantages it would confer, and that considerable attention was being paid to the subject.

In relation to the origin of reaping-machines, he said, that, at the commencement of the present century, we find a machine was introduced by a Mr. Boyce (patented), in which short scythe-like knives, attaching to a revolving cylinder, was the method by which the cutting process was carried out. This was shortly followed by an improved method of cutting, introduced by Plucknett, of Blackfriars, in which a sickle edge was substituted for the scythes of Boyce. In 1806, Gladstone, a Kircudbright mechanic, carried the improvements still further; as his machine (revolving cut) possessed an arrangement for gathering the cut

corn, and delivering it in small bundles or sheaves. In this the power was applied at the side—in the former ones it was applied at the back;—in the one *drawing*, in the others *pushing* the machine. The next attempt, that by Salmon, of Woburn, was upon a different principle. Instead of the circular cut of those which preceded it, he made use of a cutter with long blades, working in a straight line, by a reciprocating movement; with which was also combined an arrangement for gathering the corn, and laying it down in swathes.

About this time (1811), the late James Smith, of Deanston, appears to have had his attention excited by the various attempts to construct such a machine; at the same time, too, the subject was taken up by the Dalkeith Farmer's Club, which offered a premium for the most effective machine. Smith's comprehensive mind, viewing the subject both in its mechanical and agricultural relations, at once applied itself to the task, and produced a machine, which was tried the following year with considerable success. This trial enabled him to see and to remedy some of its practical defects; and in a second trial, during the next harvest, we find that the Dalkeith Society was so far satisfied as to award him the premium offered. This judgment was confirmed by the Highland Society, which, on the report made by a committee to investigate its capabilities, presented him with a piece of plate of 50*l.* value. From this time, up to 1835, Smith's machine was tested occasionally in the different harvests, and various improvements introduced. In that year, the Highland Society held their great meeting at Ayr, and the improved machine* was again exhibited with remarkable success. Its operation was shewn on a field of wheat, and is thus described by Mr. Slight, Curator of the Society's museum, who was present on the occasion:—"The operation began, not on the outside, but in the middle of the field, through which the machine left behind an open lane, where nothing was observable but a close shorn stubble—the cut corn being all laid down on one side against the standing corn. Never, perhaps, did an experiment come off with better effect, or with greater success. The general impression was, that the problem had at last been solved—that Smith's machine was complete. Not such, however, was the fact; for, notwithstanding the success and striking effects of that day's trial, the machine remained, and to this day remains, without having made any further advancement."

Three years afterwards, while on a visit at Deanston, the lecturer had an opportunity of seeing it at work in the harvest field, where, inclusive of sundry stoppages, it cut down about one Scotch acre (five roods) per hour.

While Smith's machine was still before the public, other inventors appeared: the most important of whom were Scott, of Ormiston, in 1815; Ogle, of Rennington, near Alnwick, in 1822;

* The different machines, and the particular principles involved, were more fully explained by means of diagrams.

Mann, of Raby, Cumberland (invented long before but first made public in 1832); and Bell, of Carmyllie, Forfar, in 1826.

Of the first, but little need be said. His machine, constructed on the same principle as Smith's, exhibited a want of harmony in its details, and never excited more than a temporary local attention.

Ogle's machine has more direct claims to our attention, inasmuch as a description of it, in the "*Mechanic's Magazine*" for November 1825, will exactly explain the machine now so prominently before the public, under the name of M'Cormack's reaping-machine. The framework was made like the skeleton of the body of a cart, to which were attached wheels and shafts; the horses were yoked in the usual manner, and walked by the side of the standing corn. To the right of this carriage was projected the cutting apparatus—a light frame, whose front bar was of iron, and armed with a row of teeth, three inches long, and projecting forwards. Immediately upon these teeth lay the cutter, a straight-edged steel knife, a little longer than the breadth of the corn to be cut at one passage, &c. This machine did its work very well; but, owing to want of encouragement to the inventor, and threats that were directed against the manufacturers, it never made any progress.

Mann's machine was first devised in 1820, and underwent many changes before it was publicly introduced at the Highland Society's show, held at Kelso in 1832. The trial was made, under most unfavorable circumstances, upon a field of oats, that had been ripened irregularly, and were considered so worthless that cattle had been turned down on them. Under these disadvantages, it did its work far better than could possibly have been expected; while the laying the corn in swathes was very regularly and satisfactorily performed. Mann's machine, although it failed in some respects, possessed points which are well worthy of our attention: his cutting movement, like Smith's, was rotatory; but, instead of the circular knife of the latter, he arranged his in the form of a polygon of twelve sides,—each side being composed of a flat-knife, either smooth or sickle-edged, bolted on to the periphery of the skeleton wheel, or frame, to which the motion was applied. His arrangement for collecting the cut corn off his knives consisted of a rake, travelling in the same rotation as the cutting-knife, but only at one-seventh the speed. This worked through a fixed rake, which cleared it of its contents, laying them in regular order at the side of the machine. The entire gearing appears to have been very simple, and yet equal (by means of levers) to all the changes required by irregularity of surface, and other incidental derangements.

The most important of all our reaping-machines is that invented by the Rev. P. Bell, in 1826, as it has been in constant use, year after year, since that time, when it was first brought before the Highland Society, who were so satisfied with the trials, that

they voted him 50*l.* as a reward for his invention. In 1829, at a local meeting in the Carse of Gowrie, it is reported to have cut down beans, wheat, and oats, at the rate of one acre an hour, in first-rate style. Its reputation rapidly spread throughout the neighbouring counties; and in the course of a few years, several of the machines were to be seen in operation. They were made chiefly by a firm at Dundee, who, it appears, supplied four of them to the United States, which will probably account for the great similarity which exists between this machine and one of those exhibited in the United States' department (Hussey's). In the arrangement of his machine, Mr. Bell preferred to follow Smith in the method of applying motion, by *direct propulsion*, to the less efficient method of Gladstone (*lateral traction*), which appears to have been followed in both the American machines. In Bell's we recognize the principle of the cutting-knife introduced by Salmon,—which also has been selected by one of the Americans; and in the revolving frame, which we see copied in M'Cormack's, we easily recognize the arrangement which is due to Ogle.

Bell's machine, unlike the others referred to, has been in operation for the last fourteen years.

In respect of the cost of reaping-machines, the lecturer expressed himself as somewhat dissatisfied. He said, we are accustomed to see the substitution of machinery for hand-labour followed by a far greater reduction of cost than in this instance. By the use of scythes instead of sickles or hooks, and by judiciously organizing your field staff, the entire cost of harvesting may be reduced far below 9*s.* per acre, the estimate given in the report of the jury at the Exhibition. At Cirencester, where his duties extended over a large farm, his harvest expenses, including raking stubbles, were under 5*s.* per acre;—thus giving the present machine a superiority of only 1*s.* 6*d.* per acre.

He next spoke of churns. In these machines, he said, the principles upon which the whole operation depends, appeared to be generally more or less lost sight of. The process of butter-making is merely the separation of certain globules or particles of butter from the milky fluid in which they are suspended. These, having a less specific gravity than that of the fluid, speedily ascend to the surface, where they remain in the shape of cream. This cream is skimmed off; and in that state, containing about equal parts of butter and milk, it is placed in the machine, for the purpose of being separated. Now, practice, as well as theory, shews, that this separation is dependent upon mechanical agitation, by which the globules are brought into contact with one another, and thus formed into a homogeneous mass; and also that this operation is materially influenced by the temperature at which it is carried on; but, of the sixteen different churns exhibited, only three had any arrangement at all for regulating the temperature; and not one of them possessed

any of those simple methods for increasing the agitation which we see applied so often in other machinery. In the trials which took place before the jury, some remarkable disparities were seen in their work. In the first trial (thirteen churns, temperature at 70°), the time required to make the butter varied from two minutes in one, to twenty-two minutes in another; in the second trial (five churns), it varied from 45 seconds to $2\frac{1}{2}$ minutes. In both cases, the same churn produced the largest proportion of butter. Had the trials been made in the winter, with a temperature of 40° instead of 70° , a far greater difference would have been seen in favor of the churn whose arrangement admitted of a regulated temperature, combined with the necessary amount of mechanical agitation.

In respect of the thrashing-machines, the lecturer made the following pertinent remarks:—For many years, they have been made by makers whose names seemed to satisfy the public that they were of the best descriptions; and as they got through the work for which they were intended, no notice was taken as to how it was performed, until at the Norwich meeting in 1849, when it occurred to the consulting engineer that the draught of the machine itself should be tested when empty, before its power was tested in operation. This trial demonstrated at once their imperfect construction. It shewed that some of the best four-horse machines required no less than the power of three horses to set them in motion,—thus only possessing an effective power of 25 per cent. So little, too, had the makers attended to principles in construction, that this enormous waste of power was capriciously divided between the horse-works and the barn-works. Two machines that were tested, furnish an excellent illustration of this point. In these, the whole amount of friction was nearly identical, being 278 and 281; but it was distributed in quite an opposite manner—the respective horse-works consuming 207 in the one, and only 46 in the other; while the barn-works of the one consumed only 71, while the other consumed 235. Thus, these two makers were working so irrespective of principles, that, if the the two best of the correlative parts had been put together, one horse of the four would have overcome the resistance, and a duty of 75 per cent. been obtained. In the Exhibition, last year, were machines, by the same makers, in which these remarkable errors no longer existed; and although very great differences existed in the several parts of the operation, as performed by the trial machines, still, estimating them as a whole, they were very satisfactory, exhibiting a difference of not more than 25 per cent..

The lecturer next referred to turnip and chaff-cutters,—pointing out their great utility, as well as the advantages derivable from cooking the food for cattle. He then noticed the advantages presented by carts over waggons; the benefits derivable from thorough draining, and the economy lately effected in that

operation, especially by the adoption of Fowler's method; and in conclusion, he said—let us assist in making known to the farmer, that, by means of pipes and the drainage-plough, his land may now be thorough-drained for 1*l.* 3*s.* 9*d.* per acre, instead of 6*l.* to 8*l.*, the ordinary cost of only a few years back. Let us aid in telling him how, by using the horse-hoe, he may have his work done for 6*d.* to 9*d.* per acre more opportunely and more efficiently than by hand-labour at 3*s.*—how a thrashing-machine, worked by steam-power, will cost him 7*d.* per quarter for his corn, against the 3*s.* 5*d.*, the expense by the demoralizing flail;—while, at the same time, the increase in the yield will be at least 5 per cent. Let us urgently call his attention to the reaping-machine, which, even in its present imperfect state, will cut down his corn at one-third the cost, and in one-twentieth the time, that he is now giving to his old but slow friend, the sickle. Let us make known to him, that experienced men have estimated that a saving of no less than 70*s.* per acre is effected on the turnip crop by the use of the improved cutting machines; and that a practical trial has established the fact, that one horse in a cart is better than two in a waggon. Let us assist in placing these advantages, which applied science offers, clearly before him; and when he has figured up the various items, and seen that, even in the few points adduced, a direct saving may be effected in his outgoings equal to 25*s.* per acre on his corn, and an increase effected in his incomings equal to 75*s.* per acre on his root crops—an electric acknowledgment will pass between his brain and his breeches-pocket—he will at once recognize in them the elements of a real protection—grateful above all other to an independent mind, because based on individual intelligence and exertions—a protective power which knowledge secures when opposed to ignorance, and which must ever place skill and energy far in advance of apathy or prejudice.

March 17th.

On the production of the flax plant, and the various modes of preparing its fibre for manufacture. By JAMES MACADAM, Jun.

The first part of this lecture noticed the early cultivation and use of the flax plant; and also the extent to which it is now cultivated throughout the world.

At the head of all flax-growing countries, said the lecturer, stands Russia, whose vast superficies contains many favorable localities for its production. The average annual quantity furnished by Russia, for export and home manufacture, is about 150,000 tons, of which fully one-half is exported, chiefly to Great Britain and Ireland, with a portion to France, Belgium, and other linen-manufacturing states. Russian flax ranges from very coarse to medium quality—being now worth from 26*l.* to 48*l.* per ton.

It is never fine, since the rapidity of growth during the short hot summer, and the want of moisture in the climate, tend to make the fibre either wiry and harsh, or else cottony, without the peculiar oiliness of feel, and glossiness of appearance, which are the certain indications of a fibre easily divisible on the hackle, and capable of being spun to fine Nos. of yarn.

Austria was said to produce about 65,000 tons annually; while the annual produce of France did not exceed some 25,000 to 30,000 tons, of which a portion of the finer qualities is exported. The northern departments, and more especially the districts along the river Lys, are the best adapted to its culture; and some of what is grown in them rivals the Belgian in quality. The average value at present is about 70*l.* per ton.

Holland ranks high for the excellence of her flax; and, with her neighbour, Belgium, was early celebrated for her linen manufacture—the term, *brown holland*s, being, to this day, applied to a certain kind of fabric made largely in Ireland. About 6000 to 8000 tons of fibre are annually produced, and chiefly consumed in England and Ireland. The quality is very good, and strongly resembles Irish flax.

Belgium occupies the same position as to quality that Russia does as to quantity—the Belgian flax being, indisputably, the finest in the world. From 20,000 to 25,000 tons are annually produced—a large proportion being of sorts that sell from 90*l.* to 140*l.* per ton. Great Britain, Ireland, and France, are the greatest consumers of this fine flax; although a considerable quantity is retained for manufacture in Belgium, where, among other fabrics made from it, is the exquisite lace of Brussels and Mechlin, the thread of which is, in some cases, worth double its weight in gold.

Of our own countries, Great Britain furnishes but a small quantity of flax, while Ireland produces a much larger proportion. In that kingdom, from a very early period, the linen manufacture has been successfully prosecuted; and flax culture is now progressing rapidly, and presents an important feature in Irish agricultural produce. The growth was said to have increased, during the last four years, from 53,863 to 138,609 acres, which last year's statistical returns shew to have yielded 34,000 tons of fibre; and it is calculated that the value of the crop is not much under 2,000,000*l.* This remarkable increase, where the article has to compete with foreign flax, admitted free of duty, shews the natural elements of its successful production to be present to a large extent; and, latterly, in consequence of the pains taken to introduce the best systems of culture, and the carrying out of new inventions for the after-processes, the quality of the fibre, and the manner in which it is prepared for market, are both improving. Irish flax sells at prices varying from 35*l.* to 100*l.* per ton. The province of Ulster has hitherto produced nearly all the flax grown in Ireland; but, through the exertions of the Royal Bel-

fast Flax Improvement Society to spread it over the other provinces, whose natural capabilities are equal, or, in many cases, superior, it bids fair to be generally grown throughout the island; as while, in 1848, only 2860 acres were grown without the bounds of the northern province, in 1851 there were 14,893 acres.

In many parts of Asia some flax is grown,—though, since the days of the Jewish kingdom, this branch of industry, deserting the East, has sought its extension rather in the West. In Hindostan a considerable breadth is still cultivated, solely for the seed, which is exported to England, and is all consumed by the oil-mills.

Egypt, the natal soil of the plant, and the earliest linen manufacturing country, still produces about 2500 tons of fibre annually, which is exported; but the quality is very inferior.

On the continent of America, although much land is suitable for flax, and the climate of many localities favorable to the maturing of an average quality of fibre, but little has as yet been grown. The great obstacle has been the sparsity of population and high price of labor. In the United States the crop is grown in different districts. About the Ohio, and in the Western States bordering on the Mississippi and its tributary streams, in their rich alluvion, a large breadth is grown for the seed, which is locally consumed in the oil-mills; and the cake made from it forms an item in the imports of American produce at Liverpool.

Although flax has frequently been spoken of as a prospective branch of agriculture on the continent of Australia, the lecturer stated his fear that the great aridity of climate, and the scarcity of water for steeping, would preclude any chance of success; while the dearth and small supply of labor would render the culture unremunerative. In Van Dieman's Land, however, some successful trials are said to have lately been made,—the climate having sufficient moisture, and the supply of water being pretty abundant. In New Zealand, the *Phormium tenax* has so much occupied attention, that few trials have yet been made of the *Linum usitatissimum*, with which it is often confounded; but the lecturer had no hesitation in saying, that, from their humid climate and maritime position, those islands would be peculiarly suited to its growth.

From his survey of the flax-producing countries, the lecturer concluded that the temperate zone is the flax region *par excellence*, in so far that within its limits the fibre attains the greatest length and the finest quality. Northern latitudes, at the extreme verge of this belt, or beyond it, are unfavorable to the maturing of fine fibre, in consequence of the shortness and warmth of their summers. In order to perfect a soft, yet strong, pliable, and lustrous fibre, easily divisible by mechanical means into minute filaments, a slow and regular growth is requisite. Where a powerful sun draws the plant too rapidly to maturity, the fibre is hardened, splits with difficulty, and is wanting in silkiness. In intertropical

countries the plant grows with sufficient luxuriance, but has a tendency rather to extend laterally in branches, bearing a large quantity of seed, than to push forward a slender, upright stem, almost or entirely branchless; while the fibre of hot countries is invariably coarse and hard.

Humidity being indispensable to promote regularity of growth, and to enable the plant to elaborate from the atmosphere the constituents of its fibre—chemical analysis having demonstrated that this valuable substance is chiefly derived from that source—maritime districts, especially those which first receive the evaporations of the ocean, are those in which the flax fibre is produced in the greatest perfection. Belgium, Holland, Denmark, the north-west of France, the British isles—especially Ireland—are all more favorably situated than countries within the same latitudes in the interior of the continent.

As to soil, the plant takes an extensive range, and will, in fact, grow well on almost any kind, provided the climate be favorable. In the artificially-enriched sands of Belgium, the polders of Holland, the clay-slate of Ulster, the peat of Connaught, and the limestone of central Ireland, excellent flax is grown. But, notwithstanding the great diversity of soils in which flax will succeed, the alluvial deposits of rivers furnish the best fibre.

For the production of seed, hot climates are the most favorable—the yield being greater, and the seeds being larger, plumper, and more oily than in temperate countries. Seed-crushers find the flax-seed of India the most productive, as it contains about 28 per cent. of oil, while Baltic seed gives but 22 per cent. In like manner, the seed shipped from the Black Sea and Sea of Azov, yields more oil than that from the northern parts of Russia.

The lecturer described the stem of the plant to consist of three distinct substances—the pure fibre, the ligneous stalk, and the gum, glue, or resin, incorporated with the fibre. By quantitative analysis, with incineration, the entire plant, exclusive of its seed, is stated, by Sir R. Kane, to be composed of the following elements:—

Carbon	38.72
Hydrogen	7.38
Nitrogen	.56
Oxygen	48.36
Ashes.....	5.00
	100.00

Thus, only five per cent. appears to be solid,—the rest consisting of gaseous matter. The pure fibre, when analyzed, gives a scarcely appreciable amount of ash; so that the great mass of inorganic matter is contained in the ligneous stem and the gum—the stem containing, according to the same chemist, 1.57 per cent. of ash; and the desiccated extract of the steep water, in which the gum had been chemically changed and dissolved, gave

42·01 per cent. of ash. On breaking a stem of flax, and stripping off the fibre, the interior appears hollow, like a stalk of hay. The fibre, though apparently clean, will, on microscopic examination, be found coated with a gummy or resinous matter, which prevents the minute filaments from coming asunder. As this gum cannot be separated by mechanical means, it is necessary to get rid of it by chemical decomposition.

He next proceeded to describe the various modes of retting now in use, or proposed to be used, and likewise noticed the best arrangements of apparatus for scutching the flax when retted: which subject having been fully treated in a recent number of the Journal, it will be unnecessary to detail the lecturer's remarks on these points. In closing his address, he said, he should be highly remiss were he to conclude without an allusion to the influence which the Exhibition may be estimated to produce upon the quantity and the quality of this raw material that will, in future, be furnished for the aliment of the linen manufacture. By the display of the article produced by different countries, visitors have been enabled to compare and weigh the merits and demerits of each sample; to observe in what respect the Russian differed from the Belgian, the Egyptian from the Irish, and the Dutch from the French; and to note which was suited for canvass, which for threads, and which for fine linens, damask, or cambric. In examining the fibre produced by different modes of retting, and cleaned by different methods of scutching, and in inspecting the machines exhibited, those interested in developing the resources of their respective countries, have, doubtless, carried away many useful ideas. The evident room for improvement which still exists in the retting and scutching operations, will turn many ingenious minds to the devising of more efficient modes of effecting these processes; and, indeed, since the closing of the Exhibition, several new plans respecting these have been brought forward, some of which appear to possess considerable merit.

List of Patents

That have passed the Great Seal of IRELAND, from the 17th April to the 17th May, 1852, inclusive.

To Joseph Pimlott Oates, of Lichfield, in the county of Stafford, surgeon, for certain improvements in machinery for manufacturing bricks, tiles, quarries, drain-pipes, and such other articles as are or may be made of clay or other plastic substance.

—Sealed 4th May.

George Torr, of the Chemical Works, Frimley-lane, Rotherhithe, animal charcoal-burner, for improvements in the burning animal charcoal.—Sealed 17th May.

James Pillans Wilson, and George Fergusson Wilson, both of Wandsworth, in the county of Surrey, Gents., for improvements in the preparation of wool, for the manufacture of woollen and other fabrics; and in the process of obtaining materials to be used for that purpose,—being partly in consequence of a communication from a certain foreigner, residing abroad, and partly by invention of their own.—Sealed 17th May.

List of Patents

Granted for SCOTLAND, from the 22nd April to the 22nd May, 1852.

To William Edward Newton, of the Office for Patents, 66, Chancery-lane, London, civil engineer, for improvements in the method of, and apparatus for, indicating and regulating the heat and the height and supply of water in steam-boilers; which said improvements are applicable to other purposes, such as indicating and regulating the heat of buildings, furnaces, stoves, fire-places, kilns, and ovens, and indicating the height, and regulating the supply, of water in other boilers and vessels,—being a communication.—Sealed 23rd April.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, London, mechanical draughtsman, for improvements in the manufacture of lenses,—being a communication.—Sealed 26th April.

Matthew Urwin Sears, of 36, Burton-crescent, St. Pancras parish, London, commission agent, for the improved construction of guns and cannons, and manufacture of cartridges for the loading or charging thereof,—being a communication.—Sealed 26th April.

Stewart McGlashen, of Edinburgh, sculptor, for the application of certain mechanical powers to lifting, removing, and preserving trees, houses, and other bodies.—Sealed 28th April.

Thomas Bell, of Don Alkali Works, South Shields, for improvements in the manufacture of sulphuric acid.—Sealed 28th April.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, London, mechanical draughtsman, for an invention for preventing the incrustation of steam-boilers; which invention is also applicable to the preservation of metals and wood,—being a communication.—Sealed 28th April.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, London, mechanical draughtsman, for improvements in the method of manufacturing, and in machinery to be used in the manufacture of, wood-screws,—part of which improvements is applicable to the arranging and feeding of pins, and other like articles; and also improvements in assorting screws, pins,

and other articles of various sizes,—being a communication.—Sealed 30th April.

George Frederick Muntz, jun., of Birmingham, for improvements in the manufacture of metal tubes.—Sealed 3rd May.

William Thomas, of Exe Island, in the county of Devon, engineer, for certain improvements in the construction of apparatus and machinery for economizing fuel, in the generation of steam, and in machinery for propelling on land and water.—Sealed 5th May.

William Gillespie, of Torbane Hill, in the county of Linlithgow, for an improved apparatus, instrument, or means for ascertaining or setting off the slope or level of drain-banks, inclines, or works of any description, whether natural or artificial, or under land or water.—Sealed 5th May.

John Campbell, of Bowfield, Renfrewshire, bleacher, for improvements in the manufacture and treatment or finishing of textile fabrics and materials, and in the machinery or apparatus used therein.—Sealed 10th May.

Julian Bernard, of Guildford-street, Russell-square, London, for improvements in the manufacture of leather, or dressed skins; of materials to be used in lieu thereof; of boots and shoes; and in materials, machinery, and apparatus connected with, or to be employed in, such manufacture.—Sealed 10th May.

Richard Christopher Mansell, of Ashford, Kent, for improvements in the construction of railways, in railway rolling stock, and in the machinery for manufacturing the same.—Sealed 10th May.

George Leopold Ludwig Kufahl, of Christopher-street, Finsbury, London, engineer, for improvements in fire-arms.—Sealed 11th May.

David Dick, of Paisley, machine-maker, for improvements in the manufacture and treatment or finishing of textile fabrics and materials.—Sealed 11th May.

Charles Ewing, of Bodorgan, in the county of Anglesea, steward and gardener, for an improved method or methods of construction, applicable to architectural and horticultural purposes.—Sealed 11th May.

Anthony Granara, of Leicester-place, Leicester-square, London, hotel-keeper, for improved apparatus for lubricating machinery,—being a communication.—Sealed 14th May.

Clemence Augustus Kurtz, of Manchester, manufacturing chemist, for an improvement in all preparations of every description of madder roots, and ground madder, in or from whatever country the same are prepared; also in munjeet, in the root and stem from whatever country.—Sealed 17th May.

William Watt, of Glasgow, manufacturing chemist, for improvements in the treatment and preparation of flax, or other fibrous substances, and the application of some of the products to certain purposes.—Sealed 17th May.

Peter Fairbairn, of Leeds, machinist, and Peter Swires Horsman, of Leeds, flax-dresser, for certain improvements in the process

of preparing flax and hemp, for the purpose of heckling; and also machinery for heckling flax, hemp, China grass, and other vegetable fibrous substances.—Sealed 17th May.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, London, civil engineer, for improvements in the manufacture of coke, and in the application of the gaseous products arising therefrom to useful purposes,—being a communication.—Sealed 19th May.

New Patents

SEALED IN ENGLAND.

1852.

To William Exall, of Reading, in the county of Berks, engineer, for improvements in the process, composition, or combination of materials, machinery and apparatus, for making bread and biscuits; part of which machinery is applicable to the mixing and kneading of plastic substances in general,—being partly a communication. Sealed 27th April—6 months for enrolment.

Alfred Taylor, of Warwick-lane, in the City of London, and Henry George Frasi, of Herbert-street, North-road, in the county of Middlesex, for improvements in heating and supplying water for baths and other uses; in the construction of water-closets, and in supplying them with water; and in cocks for drawing off liquids. Sealed 27th April—6 months for enrolment.

William Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in machinery for weaving, coloring, and marking fabrics,—being a communication. Sealed 28th April—6 months for enrolment.

Thomas Richardson, of Newcastle-upon-Tyne, for improvements in treating matters containing lead, tin, antimony, zinc, or silver, and in obtaining such metals or products thereof. Sealed 28th April—6 months for enrolment.

Charles Fisher, of South Hackney, in the county of Middlesex, for improvements in transferring ornamental designs on to woven or textile fabrics, and in the apparatus connected therewith. Sealed 29th April—6 months for enrolment.

John Linton Arabin Simmons, of Oxford-terrace, Hyde Park, in the county of Middlesex, Captain in the Royal Engineers, and Thomas Walker, of the Brunswick Iron Works, Wednesbury, in the county of Stafford, Esq., for improvements in the manufacture of ordnance, and in the construction and manufacture of carriages and traversing apparatus for manœuvring the same. Sealed 29th April—6 months for enrolment.

Peter Bruff, of Ipswich, in the county of Suffolk, civil engineer, for improvements in the construction of the permanent way of rail, tram, or other roads, and in the rolling stock or apparatus used therefor. Sealed 29th April—6 months for inrolment.

James Fletcher, of Leyland, in the county of Lancaster, bleacher, for improvements in machinery or apparatus for stretching and drying woven fabrics. Sealed 29th April—6 months for inrolment.

John Hincks, of Birmingham, manufacturer, and Eugene Nicolle, of Birmingham aforesaid, civil engineer, for a new or improved composition, or new or improved compositions, and machinery for pressing or moulding the same; which machinery is also applicable to moulding or pressing other substances. Sealed 29th April—6 months for inrolment.

George Goodman, junior, of Birmingham, in the county of Warwick, manufacturer, for an improved method or improved methods of ornamenting japanned metal and papier-maché wares. Sealed 29th April—6 months for inrolment.

Stewart M'Glashen, of Edinburgh, Scotland, sculptor, for the application of certain mechanical powers to lifting, removing, and preserving trees, houses, and other bodies. Sealed 29th April—6 months for inrolment.

John Robinson, of Rochdale, in the county of Lancaster, timber merchant, for improvements in machinery or apparatus for shaping wood into mouldings and other forms. Sealed 29th April—6 months for inrolment.

John Cumming, of Paisley, in the county of Renfrew, N. B., pattern designer, for improvements in the production of surfaces for printing or ornamenting fabrics. Sealed 29th April—6 months for inrolment.

Alexander Parkes, of Pembrey, in the county of Carmarthen, chemist, for improvements in obtaining and separating certain metals. Sealed 1st May—6 months for inrolment.

Hugh Lee Pattinson, of Scots House, near Newcastle-on-Tyne, manufacturing chemist, for improvements in smelting certain substances containing lead. Sealed 1st May—6 months for inrolment.

John Moore, of Arthurstown, in the county of Wexford, Ireland, for improvements in nautical instruments applicable for ascertaining and indicating the true spherical course and distance between port and port. Sealed 1st May—6 months for inrolment.

James Johnson, of Waterloo-place, Haggerstone-bridge, King-land, in the county of Middlesex, hat manufacturer, for certain improvements in the manufacture of hats. Sealed 1st May—6 months for inrolment.

Thomas Mosdell Smith, of Hammersmith, Gent., for improve-

ments in the manufacture of wax candles. Sealed 1st May—6 months for inrolment.

William Wood, of Pontefract, in the county of York, carpet manufacturer, for improvements in the manufacture of carpets and other fabrics, and in apparatus or machinery connected therewith. Sealed 1st May—6 months for inrolment.

Charles Thomas, of Bristol, soap manufacturer, for improvements in the manufacture of soap. Sealed 1st May—6 months for inrolment.

Edward Gee, of Liverpool, merchant, for improvements in apparatus for roasting coffee and cocoa. Sealed 1st May—6 months for inrolment.

Henry Bridson, of Bolton, in the county of Lancaster, bleacher and finisher, for improvements in machinery for stretching, drying, and finishing woven fabrics. Sealed 1st May—6 months for inrolment.

Augustus Siebe, of Denmark-street, Soho, in the county of Middlesex, engineer and machinist, for improvements in machinery for manufacturing paper,—being partly a communication. Sealed 1st May—6 months for inrolment.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in the manufacture of printing surfaces,—being a communication. Sealed 1st May—6 months for inrolment.

Richard Archibald Brooman, of the firm of J. C. Robinson & Co., of Fleet-street, in the City of London, for improvements in paddle-wheels,—being a communication. Sealed 4th May—6 months for inrolment.

Richard Jordan Gatling, of the City of New York, United States of America, for certain improvements in machinery for seeding grain. Sealed 4th May—6 months for inrolment.

George Robins Booth, of the Wandsworth-road, in the county of Surrey, for improvements in the manufacture of gas. Sealed 8th May—6 months for inrolment.

George Frederick Muntz, junior, of Birmingham, for improvements in the manufacture of metal tubes. Sealed 8th May—6 months for inrolment.

Joseph Jepson Oddy Taylor, of Gracechurch-street, in the City of London, naval engineer, for improvements in ships, boats, and vessels, and in certain articles of ships' furniture. Sealed 8th May—6 months for inrolment.

William Little Tizard, of Aldgate High-street, in the City of London, brewers' engineer, for improvements in machinery, apparatus, and processes for the preparation of grain, and for its conversion into malt, saccharine, vinous, alcoholic, and acetous liquors. Sealed 8th May—6 months for inrolment.

Alexandre Jules Saillant, junior, of 26, Rue Vivienne, Paris, France, tailor, for certain improvements in the manufacture of articles of dress. Sealed 8th May—6 months for inrolment.

John Campbell, of Bowfield, N. B., bleacher, for improvements in the manufacture and treatment or finishing of textile fabrics and materials, and in the machinery or apparatus used therein. Sealed 8th May—6 months for enrolment.

William Gillespie, of Torbane-hill, in the county of Lanlithgow, Scotland, Gent., for an improved apparatus, instrument, or means, for ascertaining or setting off the slope or level of drains, banks, inclines, or works of any description, whether natural or artificial, or under land or water. Sealed 8th May—6 months for enrolment.

William Armitage, of Manchester, for an improved safety envelope, and certain improvements in the machinery to be used in the manufacture of the same. Sealed 8th May—6 months for enrolment.

Peter Fairbairn, of Leeds, in the county of York, machinist, and Peter Swires Horsman, of Leeds aforesaid, flax spinner, for certain improvements in the process of preparing flax and hemp for the purpose of heckling; and also machinery for heckling flax, hemp, China grass, and other vegetable fibrous substances. Sealed 8th May—6 months for enrolment.

Samuel Hall, of Manchester, in the county of Lancaster, agent, for certain improvements in the construction of cocks, taps, or valves. Sealed 17th May—6 months for enrolment.

George Frederick Parratt, of Piccadilly, for improvements in life rafts. Sealed 17th May—6 months for enrolment.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, civil engineer, for improvements in the construction of docks, basins, railways, and apparatus connected therewith, for raising or removing vessels or ships out of the water, or on to dry land, for the purpose of preserving or repairing the same,—being a communication. Sealed 17th May—6 months for enrolment.

William Watt, of Glasgow, in the county of Lanark, N. B., manufacturing chemist, for improvements in the treatment and preparation of flax or other fibrous substances, and the application of some of the products to certain purposes. Sealed 22nd May—6 months for enrolment.

David Dick, of Paisley, in the county of Renfrew, N. B., machine maker, for improvements in the manufacture and treatment or finishing of textile fabrics and materials. Sealed 22nd May—6 months for enrolment.

Richard Roberts, of Manchester, engineer, for certain improvements in and applicable to boats, ships, and other vessels. Sealed 22nd May—6 months for enrolment.

John Harcourt Brown, of Aberdeen, Scotland, and John Macintosh, of the same place, for improvements in the manufacture of paper and articles of paper. Sealed 22nd May—6 months for enrolment.

- Louis Victor Ruzé**, manufacturer, of Gaillon, in the Republic of France, for certain improvements in the manufacture of hat-plush and other similar silk cloths. Sealed 22nd May—6 months for inrolment.
- John James Russell**, of Wednesbury, in the county of Stafford, patent tube manufacturer, for improvements in coating metal tubes. Sealed 22nd May—6 months for inrolment.
- Edward Thomas Bainbridge**, of Saint Paul's Churchyard, for improvements in obtaining power when fluids are used. Sealed 22nd May—6 months for inrolment.
- Samuel Cunliffe Lister**, of Manningham, in the county of York, machine wool comber, for improvements in treating and preparing—before being spun—wool, cotton, and other fibrous materials. Sealed 22nd May—6 months for inrolment.
- John Swarbrick**, of Blackburn, in the county of Lancaster, fire-brick manufacturer, for certain improvements in the method of manufacturing retorts used for gas and other purposes, and in the apparatus connected therewith. Sealed 22nd May—6 months for inrolment.
- Alfred Vincent Newton**, of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for certain improvements in winnowing machines,—being a communication. Sealed 22nd May—6 months for inrolment.
- Thomas Knott Parker**, of London-wall, in the City of London, carpenter, for improvements in window sashes. Sealed 22nd May—6 months for inrolment.
- Johann Stierba**, of the firm of Messrs. Eisbrick and Co., of Prague, Bohemia, Gent., for improvements in furnaces, and in treating and utilizing certain products of combustion. Sealed 22nd May—6 months for inrolment.
- John Mason**, of Rochdale, in the county of Lancaster, machine-maker, and **George Collier**, of Halifax, in the county of York, manager, for certain improvements in preparing, spinning, twisting, doubling, and weaving cotton, wool, and other fibrous materials; also in tools or apparatus for constructing parts of machines used in such manufactures. Sealed 22nd May—6 months for inrolment.
- Joseph Walker, jun.**, of Wolverhampton, in the county of Stafford, merchant, for certain improvements in vacuum-pans, for the evaporation and crystallization of saccharine or other solutions,—being a communication. Sealed 25th May—6 months for inrolment.
- Henry Webster**, of Manthorpe, in the county of Lincoln, wheelwright, for improvements in regulating the draft in chimnies or flues. Sealed 25th May—6 months for inrolment.
-

CELESTIAL PHENOMENA FOR JUNE, 1852.

D.	H.	M.		D.	H.	M.	
1	—	—	Clock after the ☉ 2m. 28s.	17	—	—	Ceres, R. A., 8h. 40m. dec. 13. 31
—	—	—	☾ rises 7h. 14m. A.	—	—	—	Jupiter, R. A., 14h. 17m. dec. 14. 59. S.
—	—	—	☾ pass mer. 11h. 43m. A.	—	—	—	Saturn, R. A., 2h. 47m. dec. 14. 49. N.
—	—	—	☾ sets 3h. 31m. M.	—	—	—	Uranus, R. A., 2h. 20m. dec. 12. 29. N.
11 41	—	—	☿ greatest hel. lat. S.	—	—	—	Mercury pass mer. 23h. 6m.
2 6 26	—	—	Ecliptic oppo. or ☉ full moon	—	—	—	Venus pass mer. 2h. 43m.
3	—	—	Occul. 26, Sagittarii, im. 13h. 31m. em. 14h. 28m.	—	—	—	Mars pass mer. 4h. 37m.
5	—	—	Clock after the ☉ 1m. 49s.	—	—	—	Jupiter pass mer. 9h. 2m.
—	—	—	☾ rises 11h. 29m. A.	—	—	—	Saturn pass mer. 21h. 0m.
—	—	—	☾ pass mer. 2h. 40m. M.	—	—	—	Uranus pass mer. 20h. 13s.
—	—	—	☾ sets 6h. 38m. M.	4 47	—	—	☿ eclipsed, invis. Greenwich
10 31	—	—	☿'s second sat. will em.	18 16 48	—	—	Juno in ☐ with the ☉
9 8 15	—	—	☾ in ☐ or last quarter	20 3 8	—	—	☿ in conj. with the ☉ diff. of dec. 1. 53. S.
8 16	—	—	☿'s first sat. will em.	11 23	—	—	☿ in the ascending node
10	—	—	Clock after the ☉ 0m. 53s.	19 29	—	—	☉ enters Cancer, Summer sol.
—	—	—	☾ rises 1h. 10m. M.	—	—	—	Clock before the ☉ 1m. 1s.
—	—	—	☾ pass mer. 6h. 41m. M.	—	—	—	☾ rises 6h. 16m. M.
—	—	—	☾ sets 0h. 22m. A.	—	—	—	☾ pass mer. 2h. 34m. A.
11 12	—	—	☾ in Apogee	—	—	—	☾ sets 10h. 42m. A.
13 1 7	—	—	☿'s second sat. will em.	21	—	—	Pallas in Perihelion.
1 25	—	—	☿ in conj. with the ☉ diff. of dec. 4. 26. N.	22 7 43	—	—	☿ in conj. with the ☉ diff. of dec. 3. 38. S.
15 23	—	—	☿ in conj. with the ☉ diff. of dec. 2. 14. N.	23 11 53	—	—	☿ in the descending node
20 35	—	—	☿ at greatest brilliancy	24 0 5	—	—	☿'s first sat. will em.
15	—	—	Clock before the ☉ 0m. 9s.	8 47	—	—	☾ in ☐ or first quarter
—	—	—	☾ rises 2h. 39m. M.	9 46	—	—	☿'s third sat. will em.
—	—	—	☾ pass mer. 10h. 11m. M.	25	—	—	Clock before the ☉ 2m. 13s.
—	—	—	☾ sets 6h. 57m. A.	—	—	—	☾ rises 0h. 44s. A.
16 10 11	—	—	☿'s first sat. will em.	—	—	—	☾ pass mer. 6h. 53s. A.
17	—	—	Mercury, R. A., 4h. 46m. dec. 21. 42. N.	—	—	—	☾ sets 0h. 26s. M.
—	—	—	Venus, R. A., 8h. 26m. dec. 20. 13. N.	—	—	—	☾ in Perihelion
—	—	—	Mars, R. A., 10h. 21m. dec. 25. N.	27 1	—	—	☾ in Perigee
—	—	—	Vesta, R. A., 1h. 5m. dec. 10. N.	2 22	—	—	☿ in conj. with the ☉ diff. of dec. 0. 25. S.
—	—	—	Juno, R. A., 23h. 4m. dec. 12. N.	28 0 28	—	—	☿ stationary
—	—	—	Pallas, R. A., 7h. 23m. dec. 45. N.	14 53	—	—	☿ in sup. conj. with the ☉
				29	—	—	Occul. B.A.C., im. 8h. 27m., em. 9h. 26m.

J. LEWTHWAITE, Rotherhithe.

JAN 18 1918



CELESTIAL PHENOMENA FOR JUNE, 1852.

D. H. M.		D. H. M.	
1	Clock after the ☉ 2m. 28s.	17	Ceres, R. A., 8h. 40m. dec. 21.5
—	☽ rises 7h. 14m. A.	—	Jupiter, R. A., 14h. 17m. dec. 14. 59. S.
—	☽ pass mer. 11h. 43m. A.	—	Saturn, R. A., 2h. 47m. dec. 49. N.
—	☽ sets 3h. 31m. M.	—	Uranus, R. A., 2h. 20m. dec. 29. N.
11 41	☿ greatest hel. lat. S.	—	Mercury pass mer. 22h. 5a.
2 6 26	Ecliptic oppo. or ☉ full moon	—	Venus pass mer. 2h. 43a.
3	Occul. 26, Sagittarii, im. 13h. 31m. em. 14h. 28m.	—	Mars pass mer. 4h. 37m.
5	Clock after the ☉ 1m. 49s.	—	Jupiter pass mer. 9h. 2a.
—	☽ rises 11h. 29m. A.	—	Saturn pass mer. 21h. 0a.
—	☽ pass mer. 2h. 40m. M.	—	Uranus pass mer. 20h. 33a.
—	☽ sets 6h. 38m. M.	4 47	Ecliptic conj. or ☉ new moon
10 31	☿'s second sat. will em.	—	☉ eclipsed, invis. Greenwich
9 3 15	☽ in ☐ or last quarter	18 16 48	Juno in ☐ with the ☉
8 16	☿'s first sat. will em.	20 3 8	♀ in conj. with the ☽ diff. of lat. 1. 53. S.
10	Clock after the ☉ 0m. 53s.	11 23	♂ in the ascending node
—	☽ rises 1h. 10m. M.	19 29	☉ enters Cancer, Summer sol.
—	☽ pass mer. 6h. 41m. M.	—	Clock before the ☉ 1m. 14s.
—	☽ sets 0h. 22m. A.	—	☽ rises 6h. 16m. M.
11 12	☽ in Apogee	—	☽ pass mer. 2h. 34m. A.
13 1 7	☿'s second sat. will em.	—	☽ sets 10h. 42m. A.
1 25	♂ in conj. with the ☽ diff. of dec. 4. 26. N.	21	Pallas in Perihelion.
15 23	♂ in conj. with the ☽ diff. of dec. 2. 14. N.	22 7 43	♂ in conj. with the ☽ diff. of lat. 3. 38. S.
20 35	♀ at greatest brilliancy	23 11 53	♀ in the descending node
15	Clock before the ☉ 0m. 9s.	24 0 5	☿'s first sat. will em.
—	☽ rises 2h. 39m. M.	8 47	☽ in ☐ or first quarter
—	☽ pass mer. 10h. 11m. M.	9 46	☿'s third sat. will em.
—	☽ sets 5h. 57m. A.	25	Clock before the ☉ 2m. 13s.
16 10 11	☿'s first sat. will em.	—	☽ rises 0h. 44a. A.
17	Mercury, R. A., 4h. 46m. dec. 21. 42. N.	—	☽ pass mer. 6h. 53a. A.
—	Venus, R. A., 8h. 26m. dec. 20. 13. N.	—	☽ sets 0h. 26a. M.
—	Mars, R. A., 10h. 21m. dec. 25. N.	25	♀ in Perihelion
—	Vesta, R. A., 1h. 5m. dec. 10. N.	27 1	☽ in Perigee
—	Juno, R. A., 23h. 5m. dec. 12. N.	2 22	☿ in conj. with the ☽ diff. of dec. 0. 25. S.
—	Pallas, R. A., 7h. 23m. dec. 45. N.	28 0 28	♀ stationary
		14 53	♀ in sup. conj. with the ☉
		29	Occul. B.A.C., im. 8h. 27m. em. 9h. 26m.

J. LEWTHWAITE, Rotherhithe.

JAN 18 1918

12

1911

T

T

T

T

T

T

T

T

T

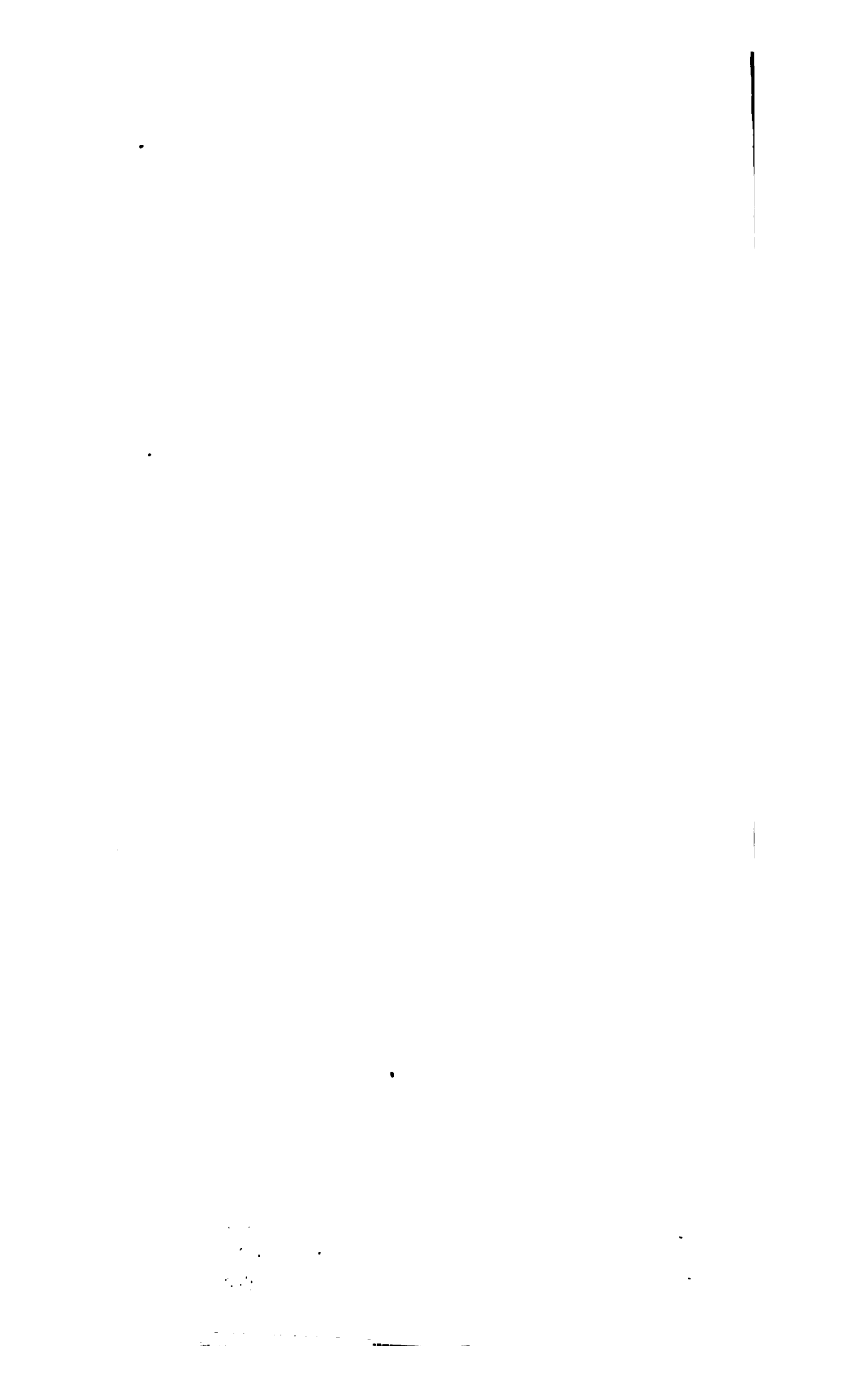
T

T

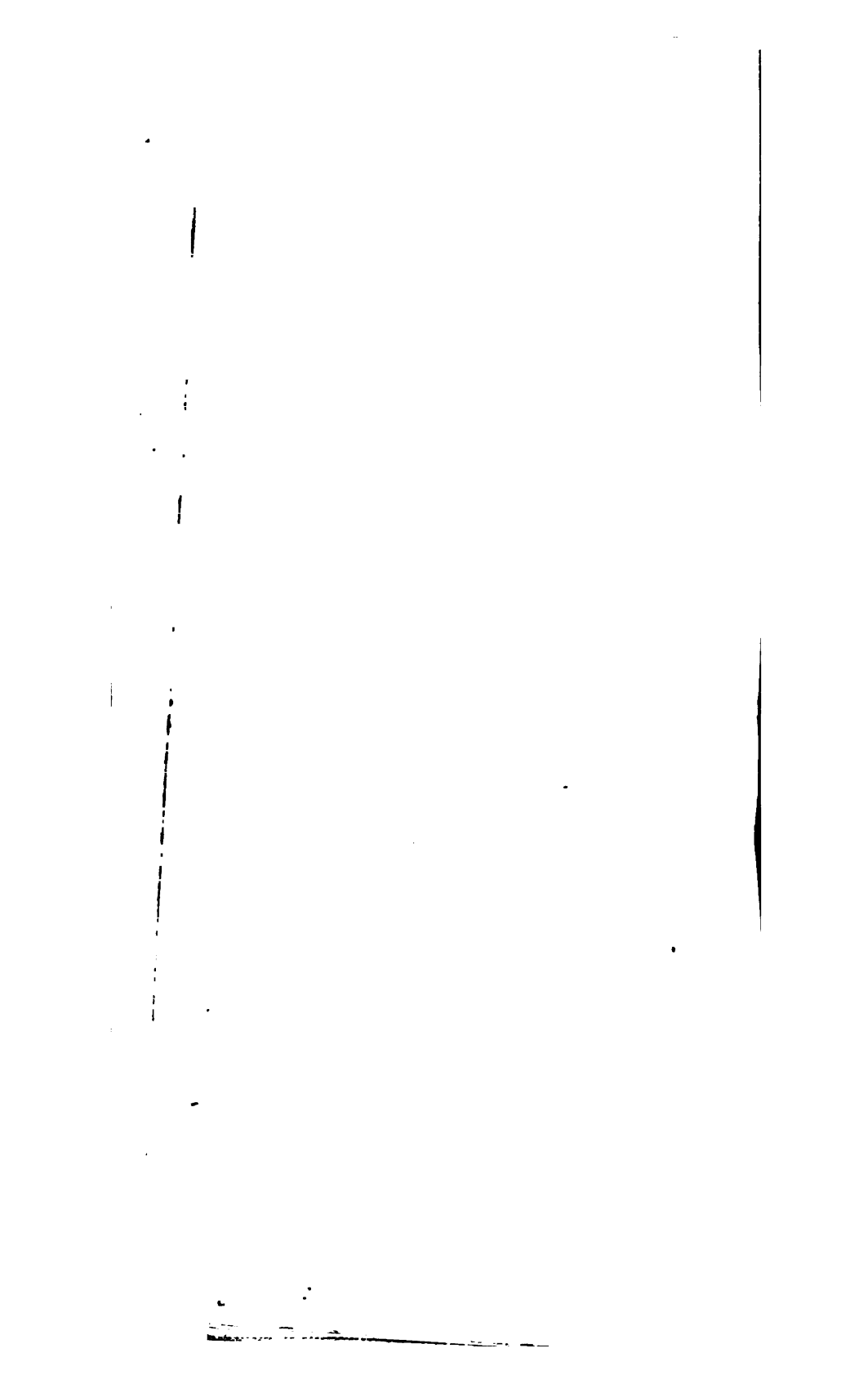
T

T

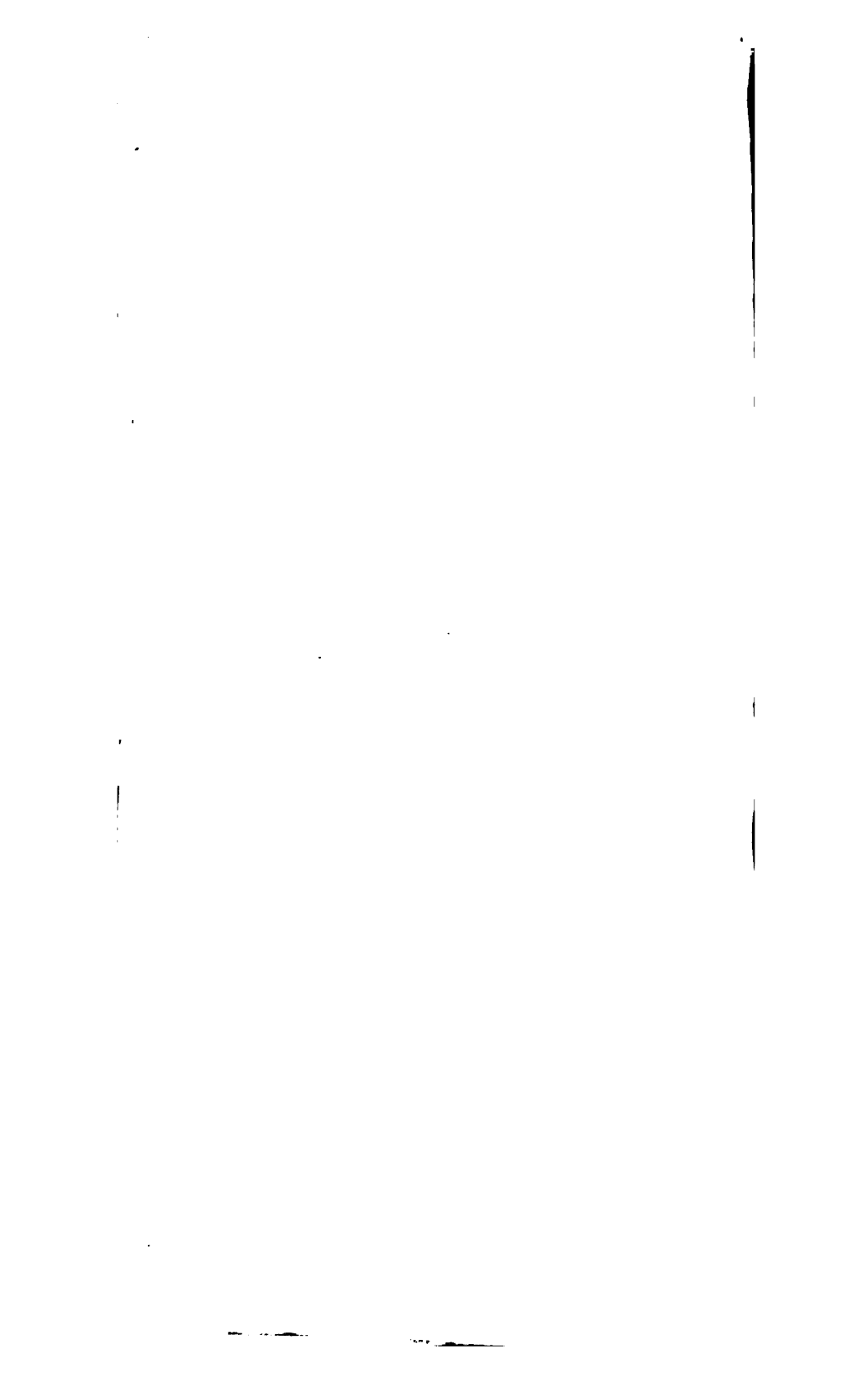


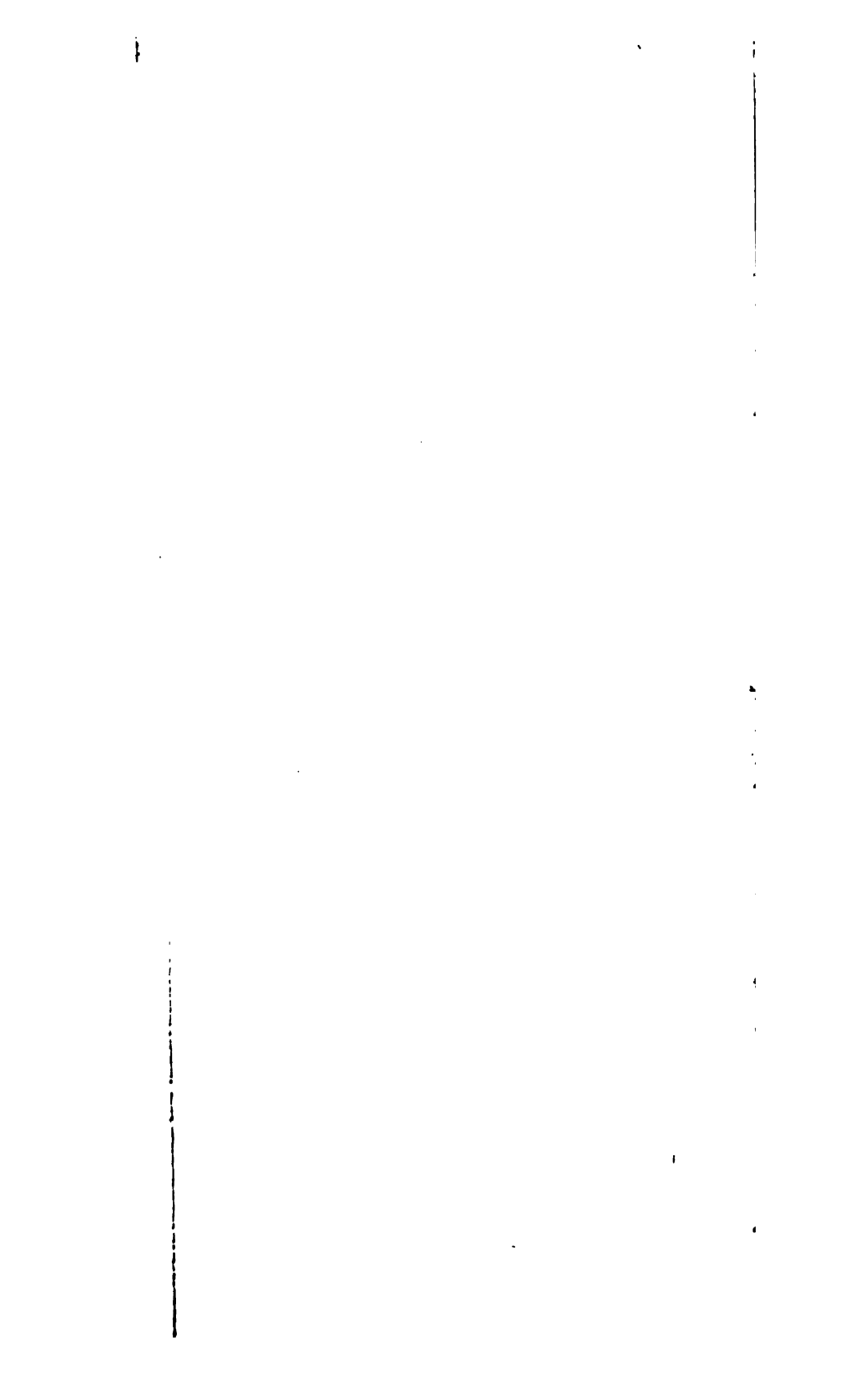


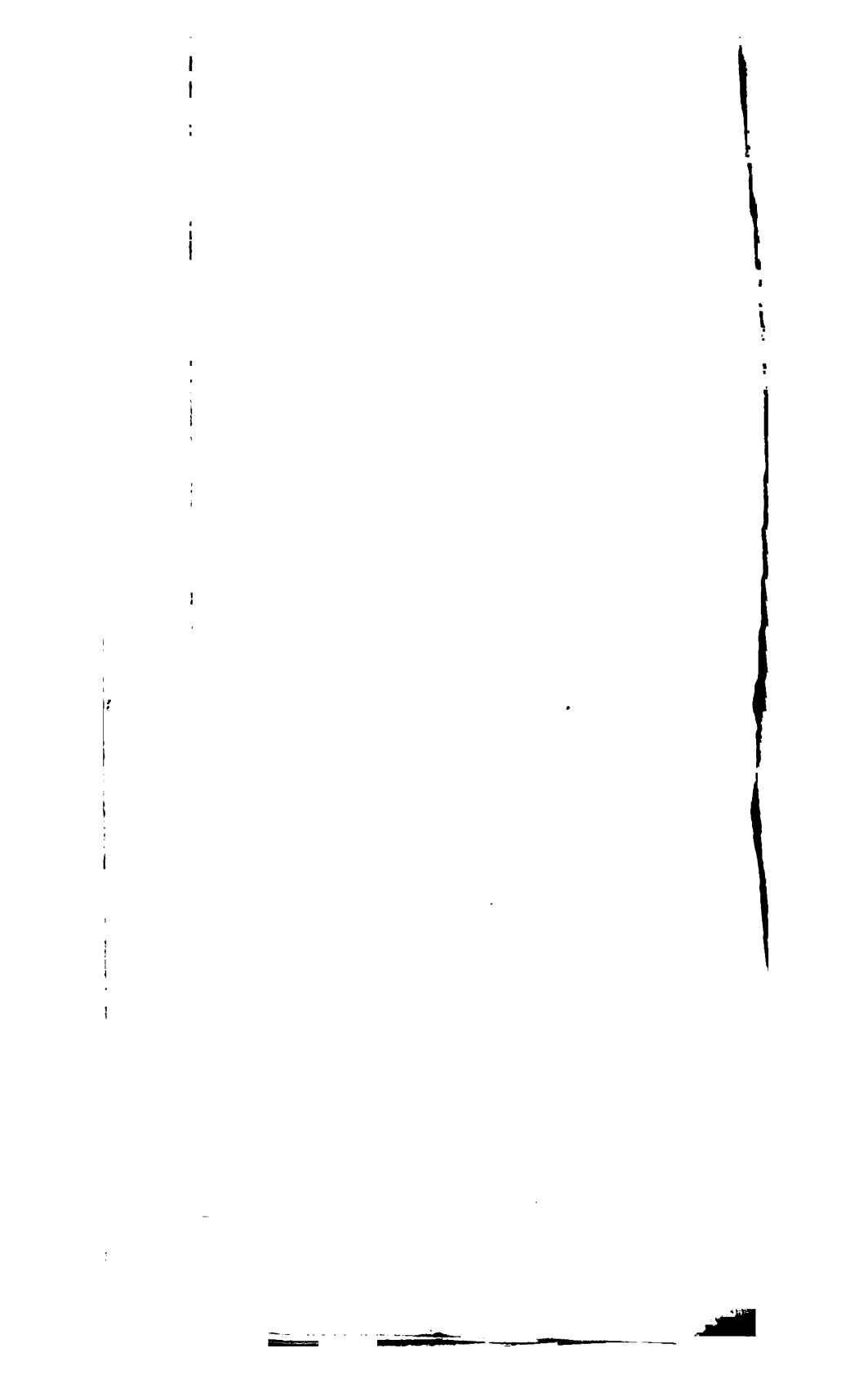












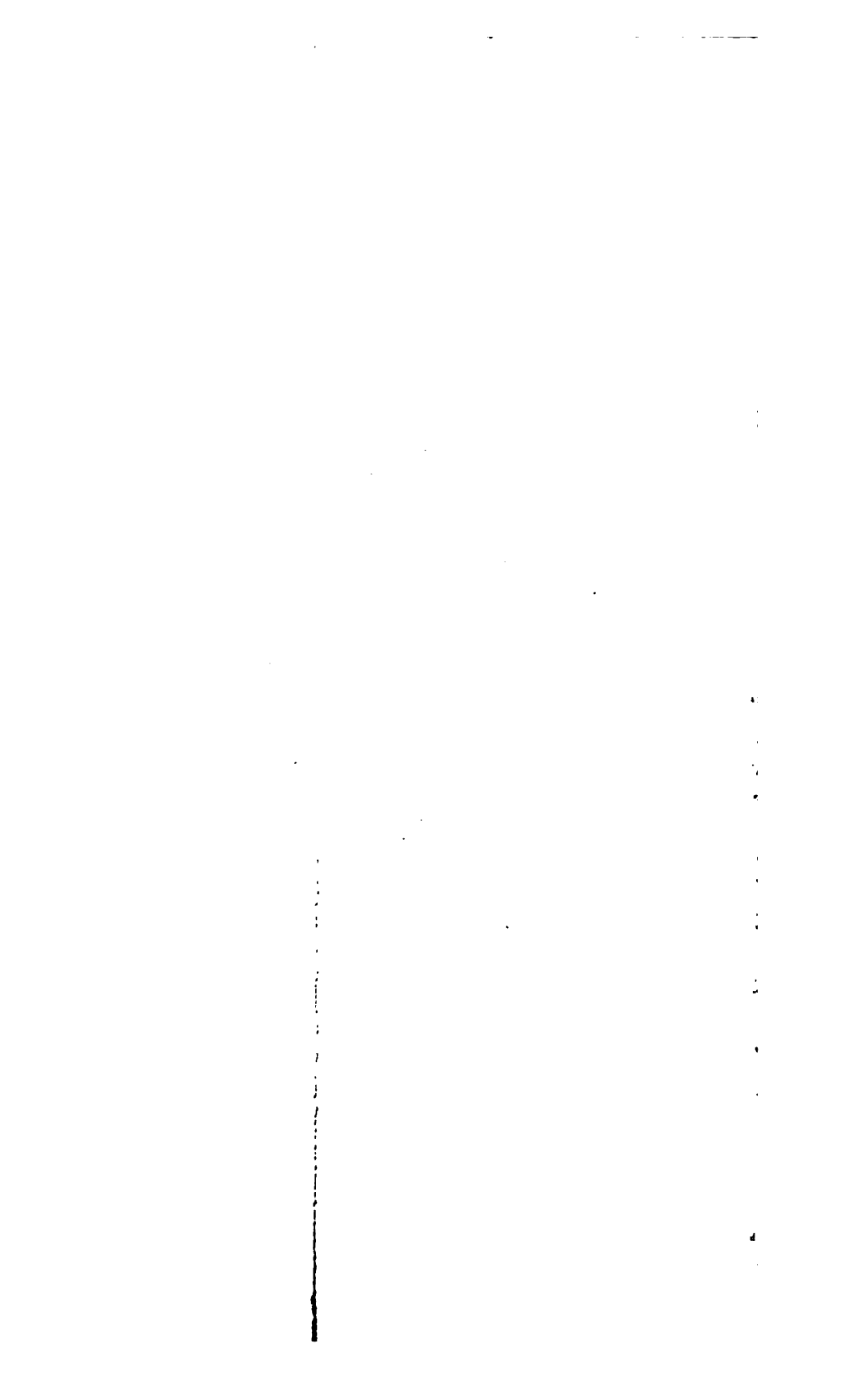
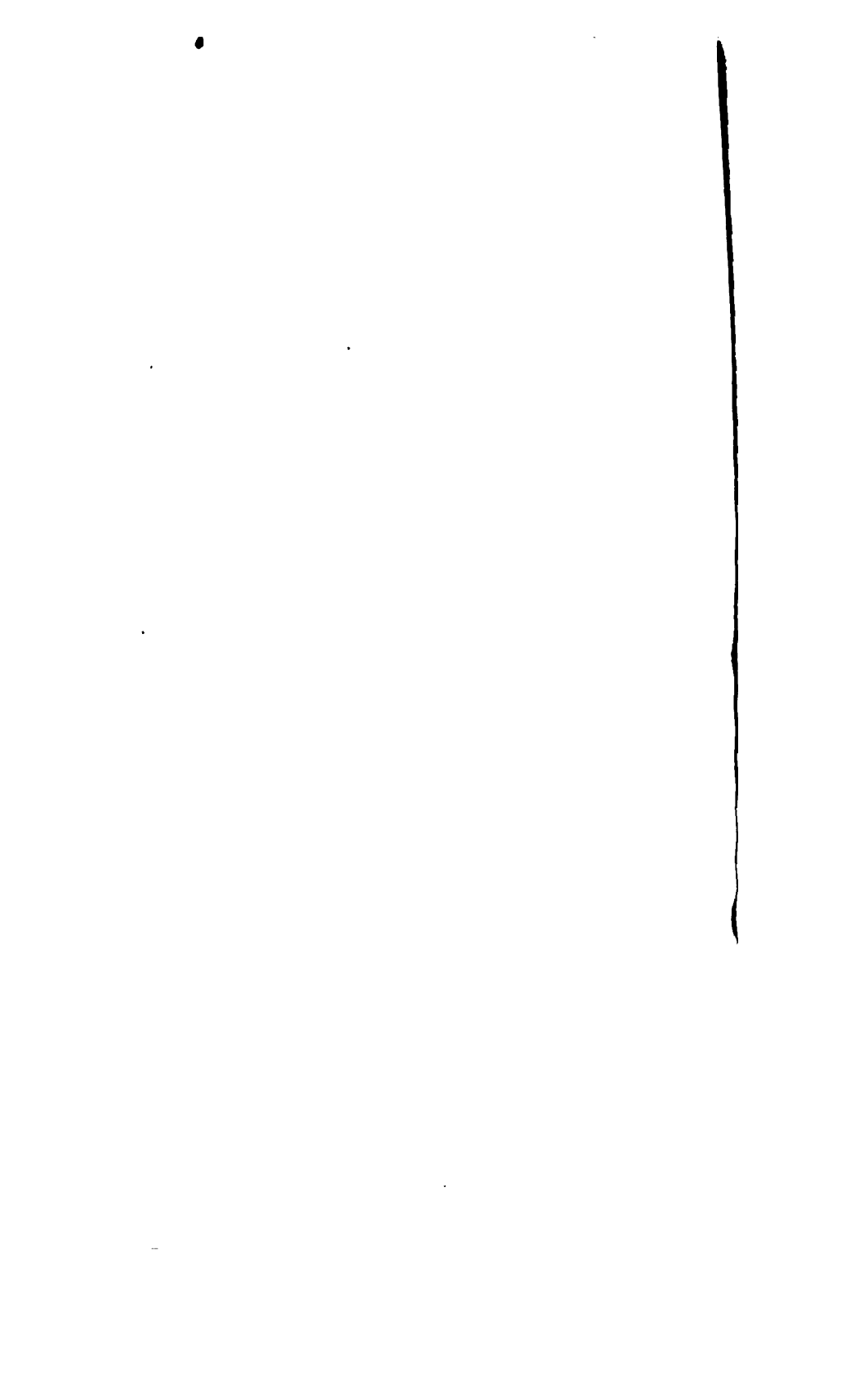


PLATE VI

CONJOINED SERIES





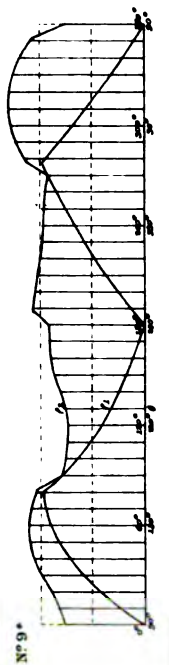
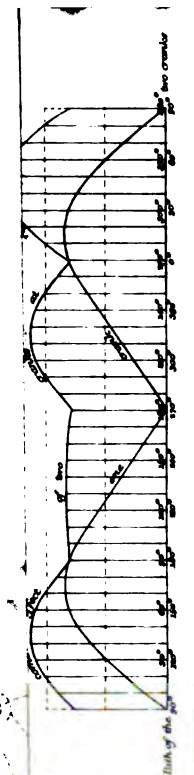
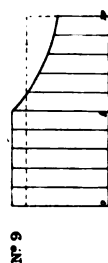
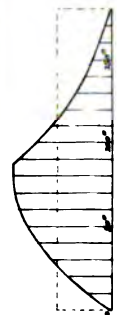
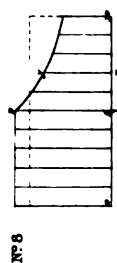
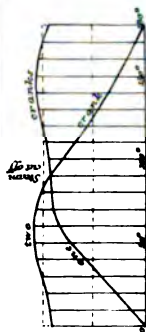
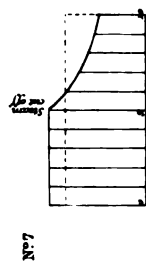


VOL. X

All



*Diagrams illustrating the action of the forces on the Crank
of a Steam Engine - by Wm Pole C.E.*



1st April 1862.

Wm Pole del.

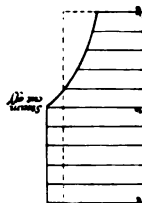
T. Shepherd sc.



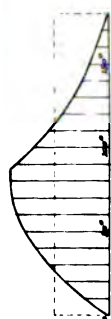
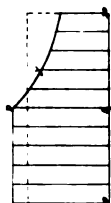
*Diagrams illustrating the action of the forces on the Crank
of a Steam Engine - by Wm. Pole C.E.*



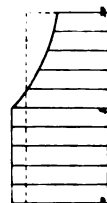
N° 7



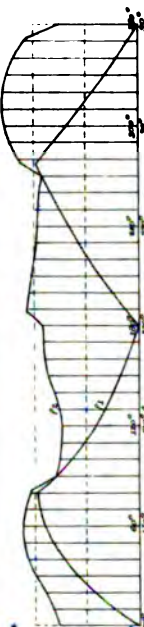
N° 8



N° 9



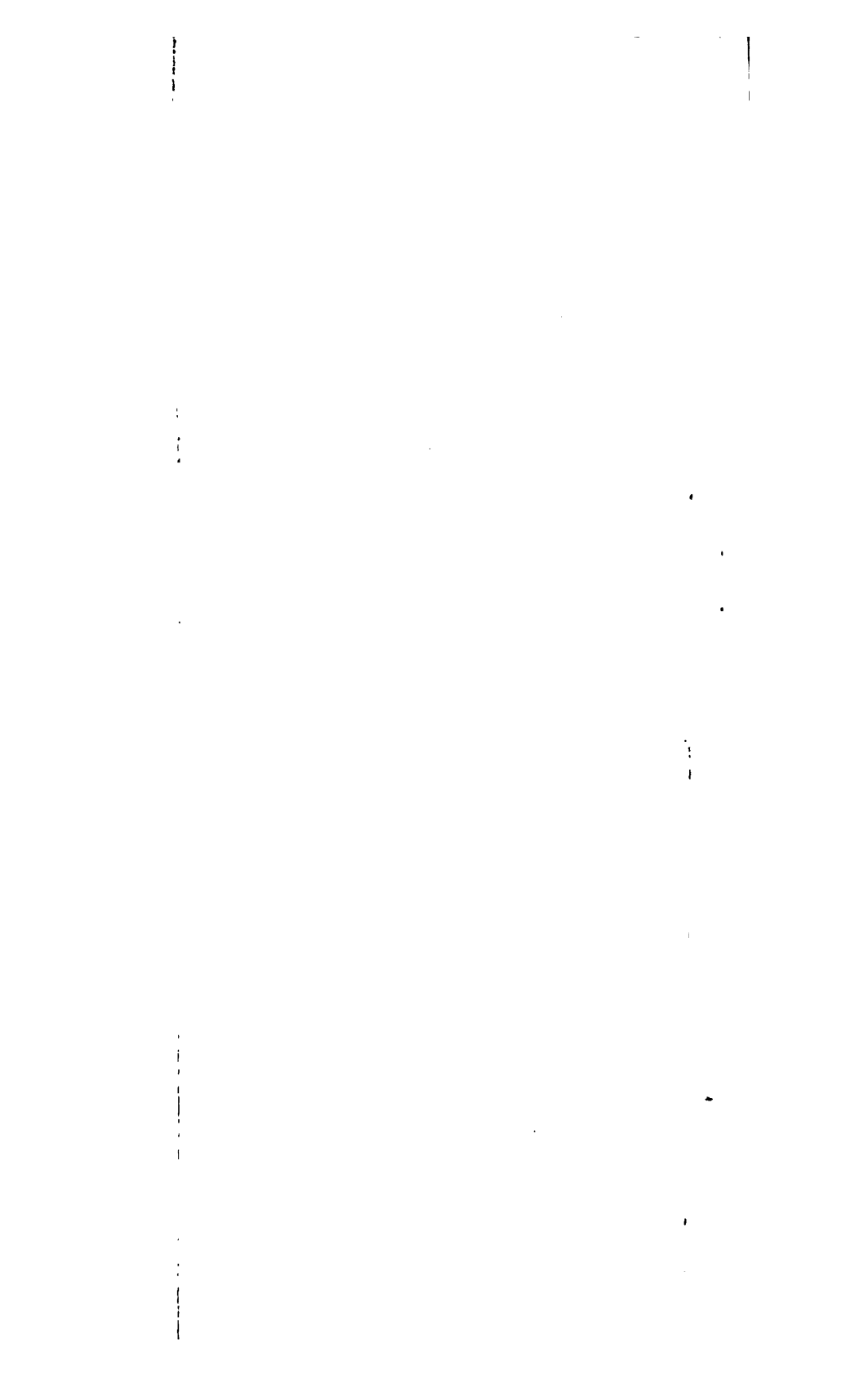
N° 9 *

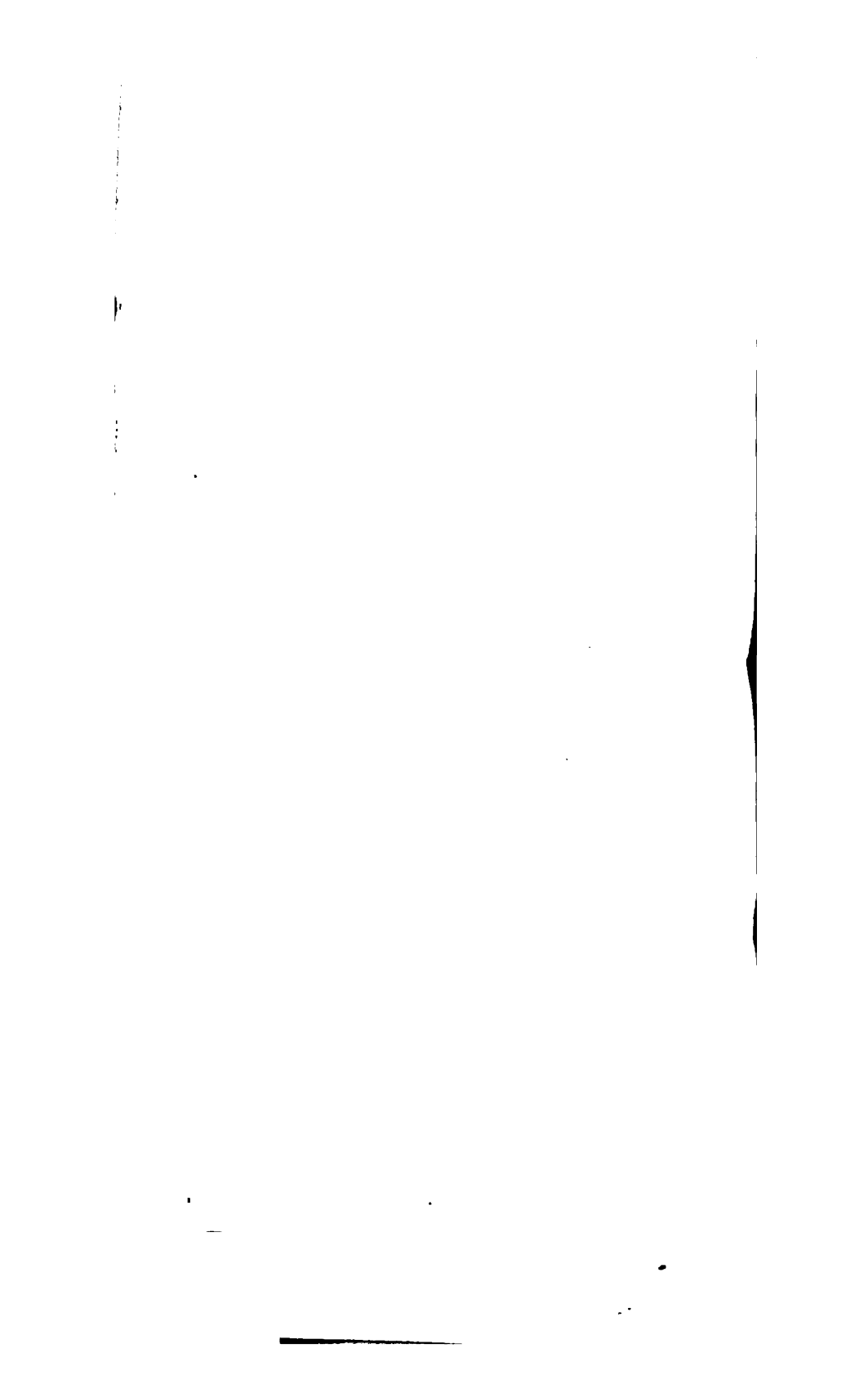


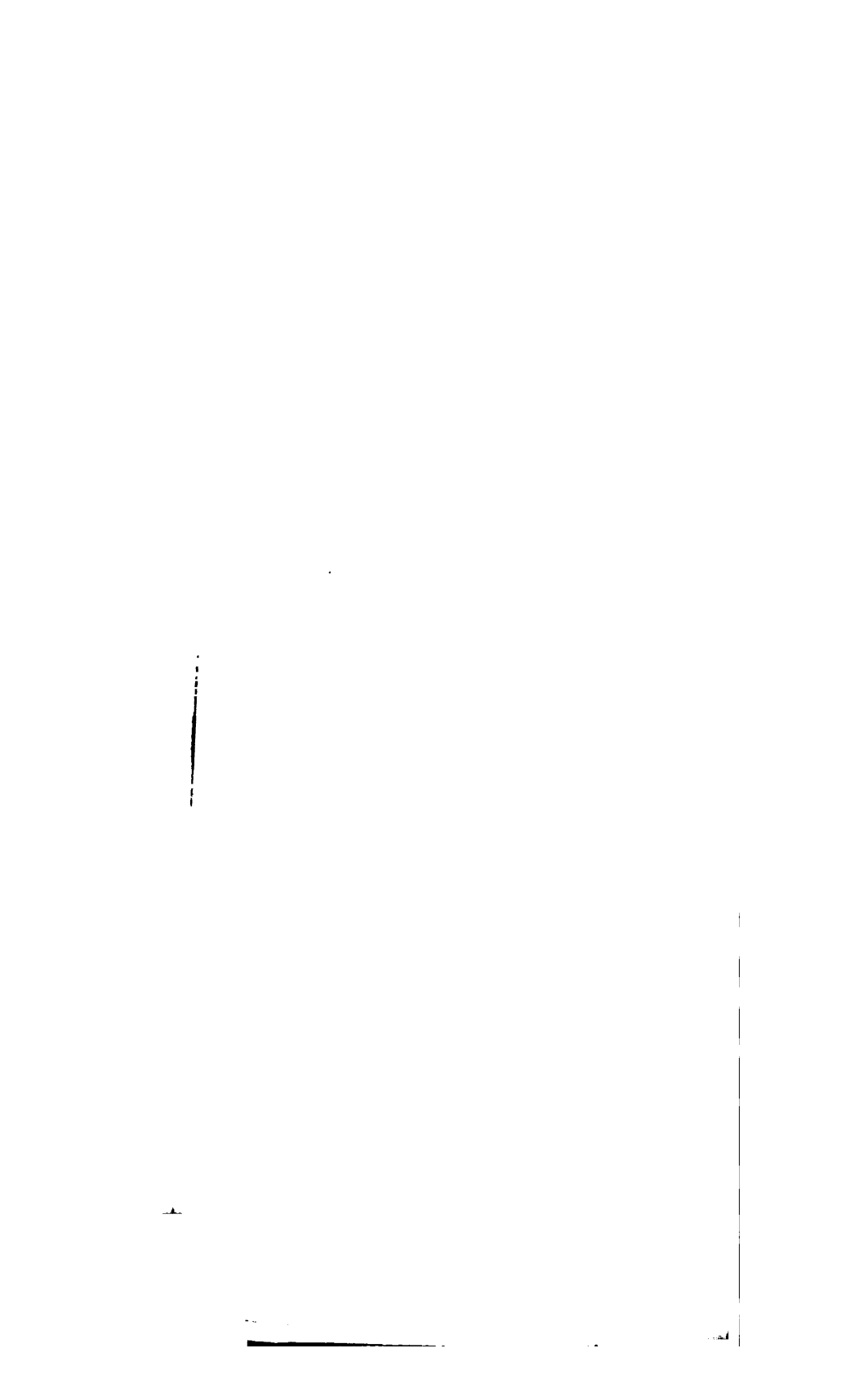
N° 12 *

1st April, 1852









22

L

L

L

L